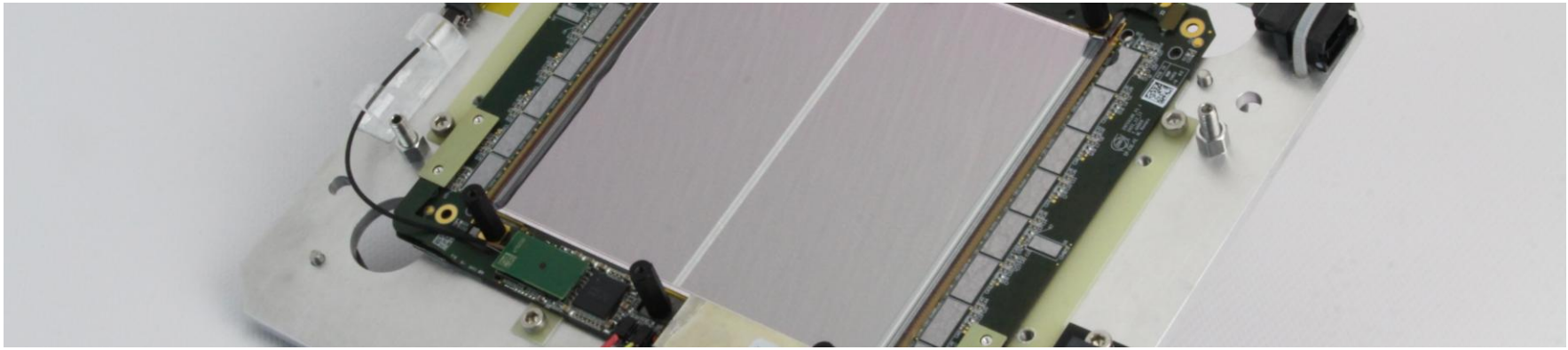
Start of 2S Module Production

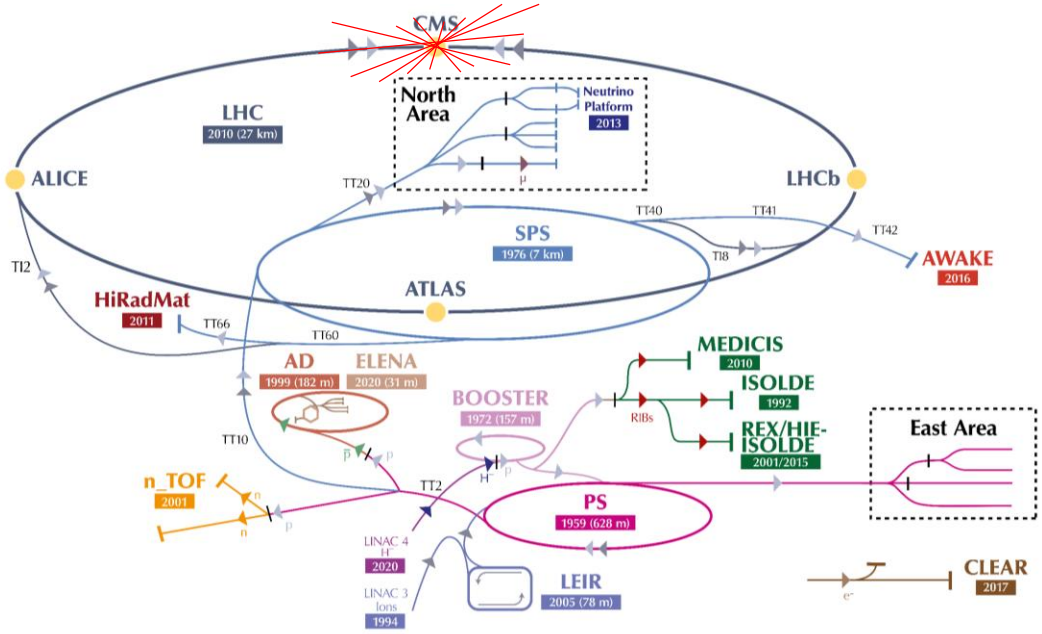
ETP 2S Module Production Meeting – 03.03.2025

●Stefan Maier

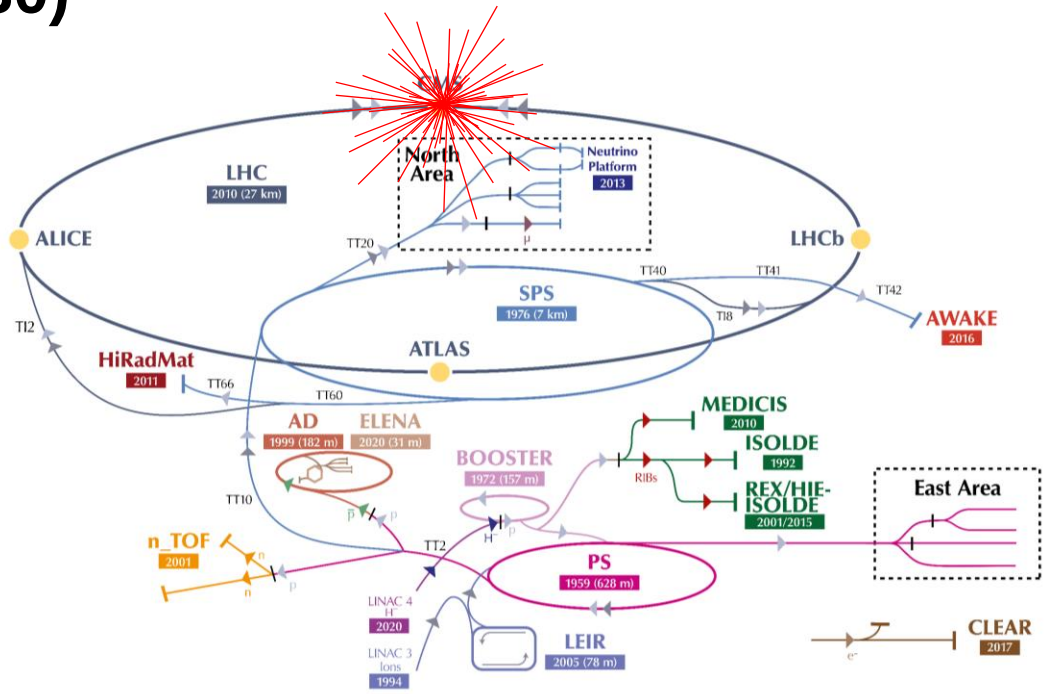


WHY?

LHC


CMS
LHC
2010 (27 km)
North Area
Neutrino Platform
2013
ALICE
LHCb
TT20
SPS
1976 (7 km)
TT40
TT41
TT42
TI8
AWAKE
2016
TI2
HiRadMat
2011
TT66
TT60
ATLAS
AD
1999 (182 m)
ELENA
2020 (31 m)
BOOSTER
1972 (157 m)
MEDICIS
2010
ISOLDE
1992
RIBs
REX/HIE-ISOLDE
2001/2015
East Area
TT10
n_TOF
2001
TT2
PS
1959 (628 m)
LINAC 4
2020
LINAC 3
Ions
1994
LEIR
2005 (78 m)
CLEAR
2017

HL-LHC (2030)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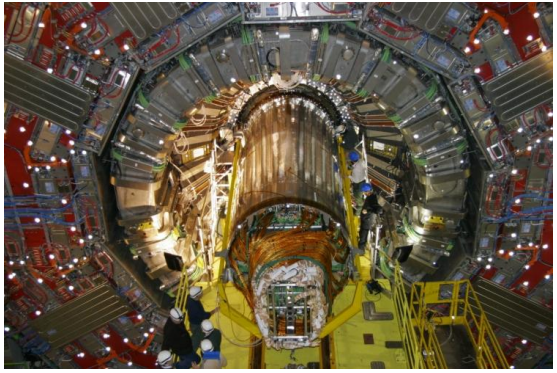
CLEAR
2017

HL-LHC (2030)

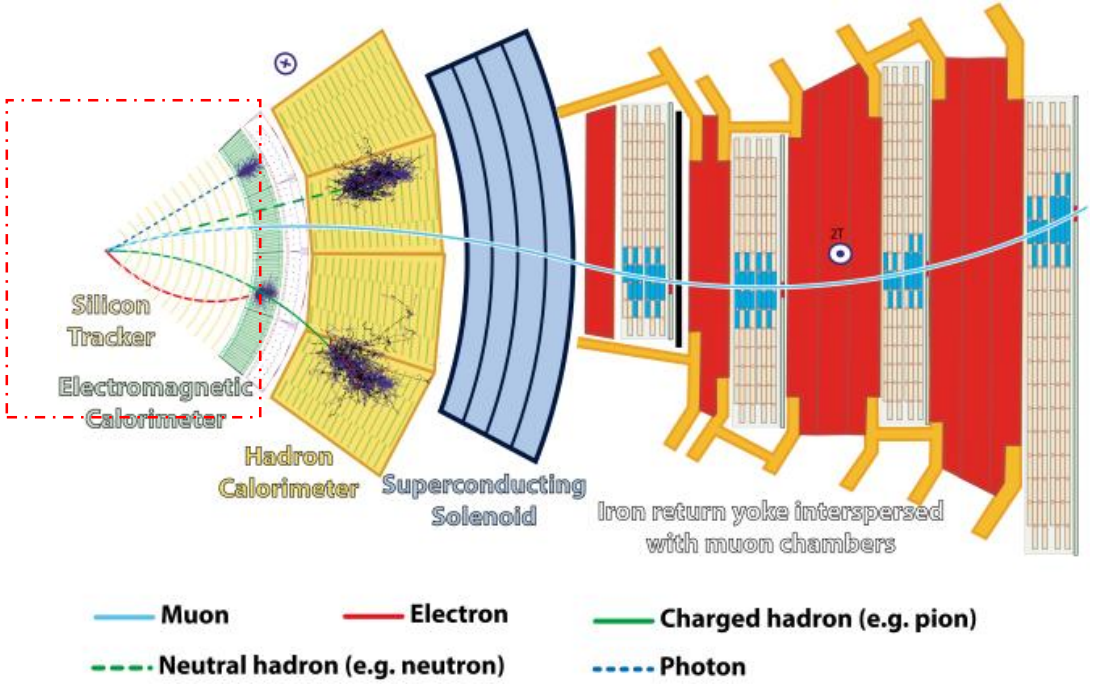
- Accelerator will become more powerful = More data / time
- Improve search for interesting physics
- After the collision, more particles than currently will fly through our detector
- Current detector parts are old, and will not cope with the new environment
  →Upgrade large parts of the detector will be upgraded: “Phase 2 Upgrade”

Tracker Upgrade

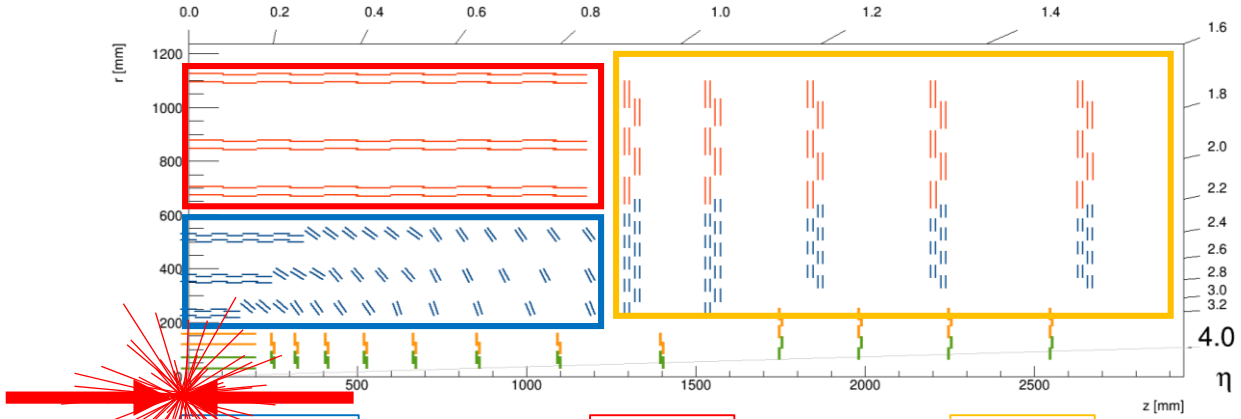
- Tracker: Most inner part of the detector will be completely replaced

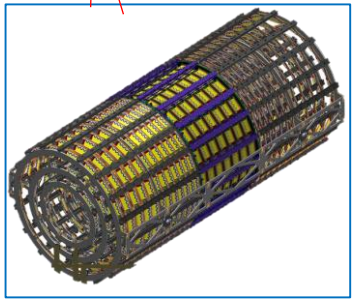


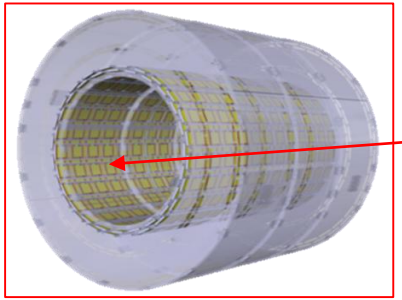
- Old one out, new one in

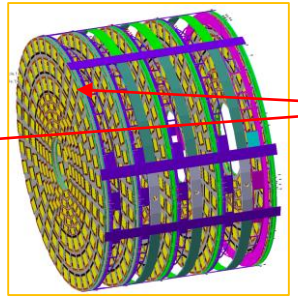


The CMS Phase-2 Outer Tracker





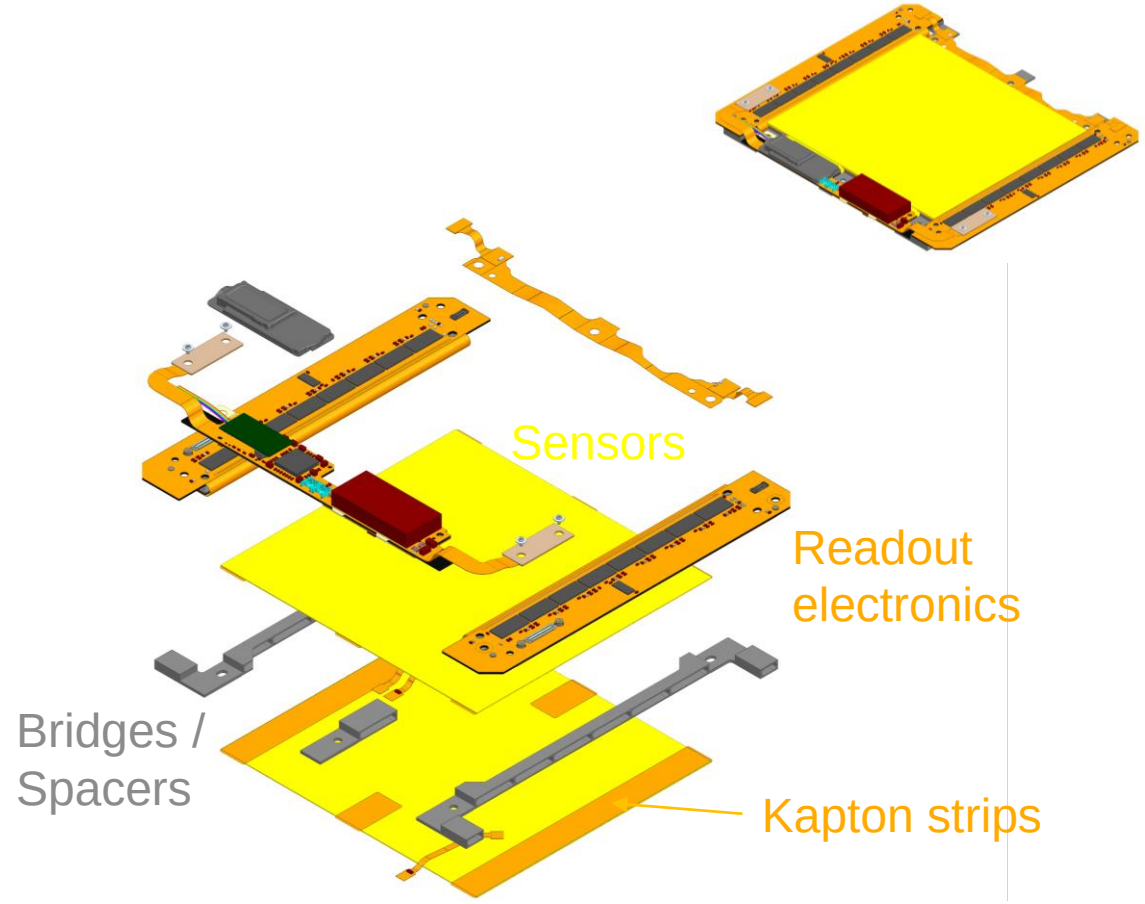


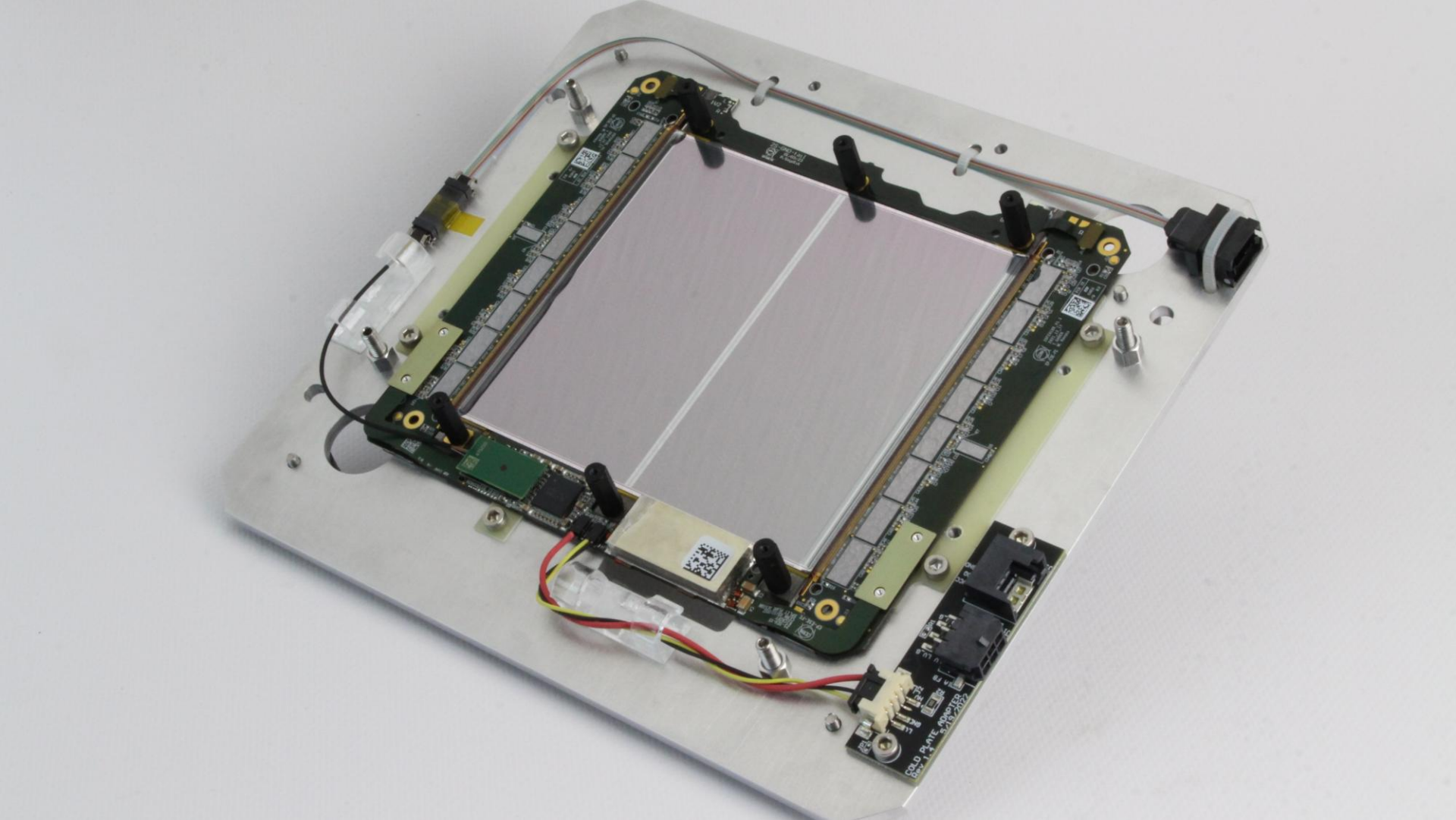


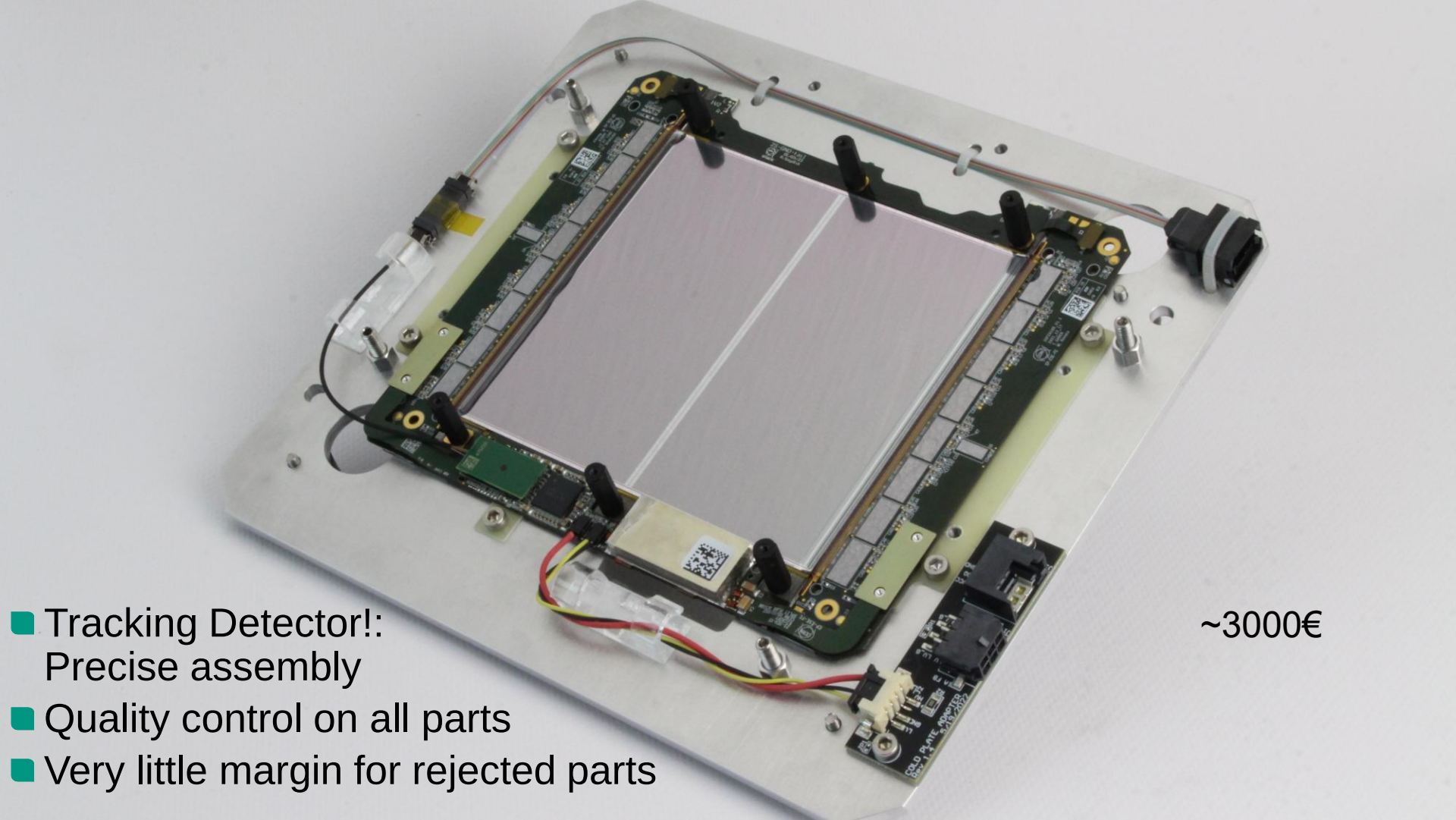
Yellow parts:
Modules

The 2S Module

- Double-layered silicon strip detector module
- Electronics
  - 2 Front-end hybrids (FEH)
  - 1 Service hybrid (SEH)
  - 1 GND Balancer
  - HV Tails
- Mechanics
  - 3 (4) Al-CF spacers
  - Kapton isolation strips




COLD PLATE ADAPTER



- Tracking Detector!:
  Precise assembly
- Quality control on all parts
- Very little margin for rejected parts

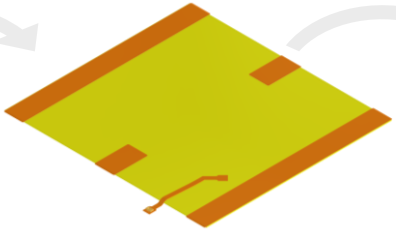
~3000€

Assembly and Test Procedures of 2S Modules

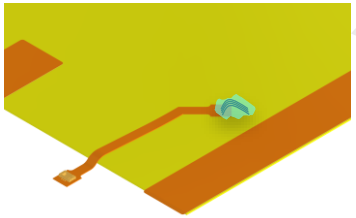
1. Glue polyimide HV isolation and attach HV tails on sensor backside

- Check dicing precision (metrology)

2. Wire-bond and encapsulate HV tails

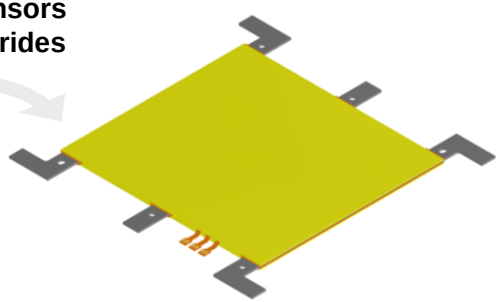


- Optical inspection



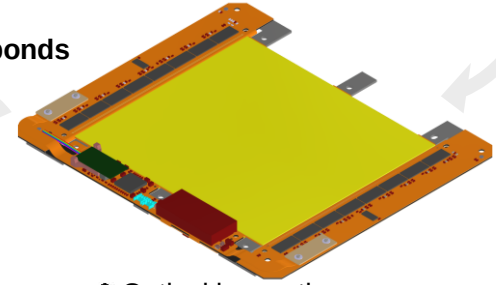
- HV test backside isolation
- Sensor I(V)

3. Glue sensors on Al-CF brides



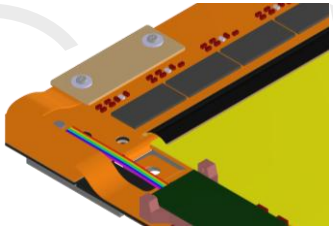
- Module metrology

4. Glue readout and service hybrids on bare module



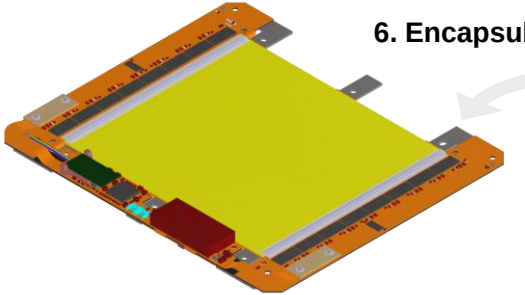
- Optical inspection
- (HV/LV test)

5. Place ~4000 wire-bonds



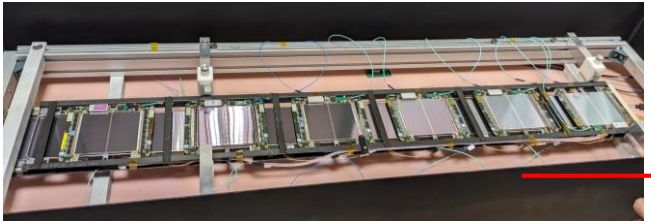
- Module test

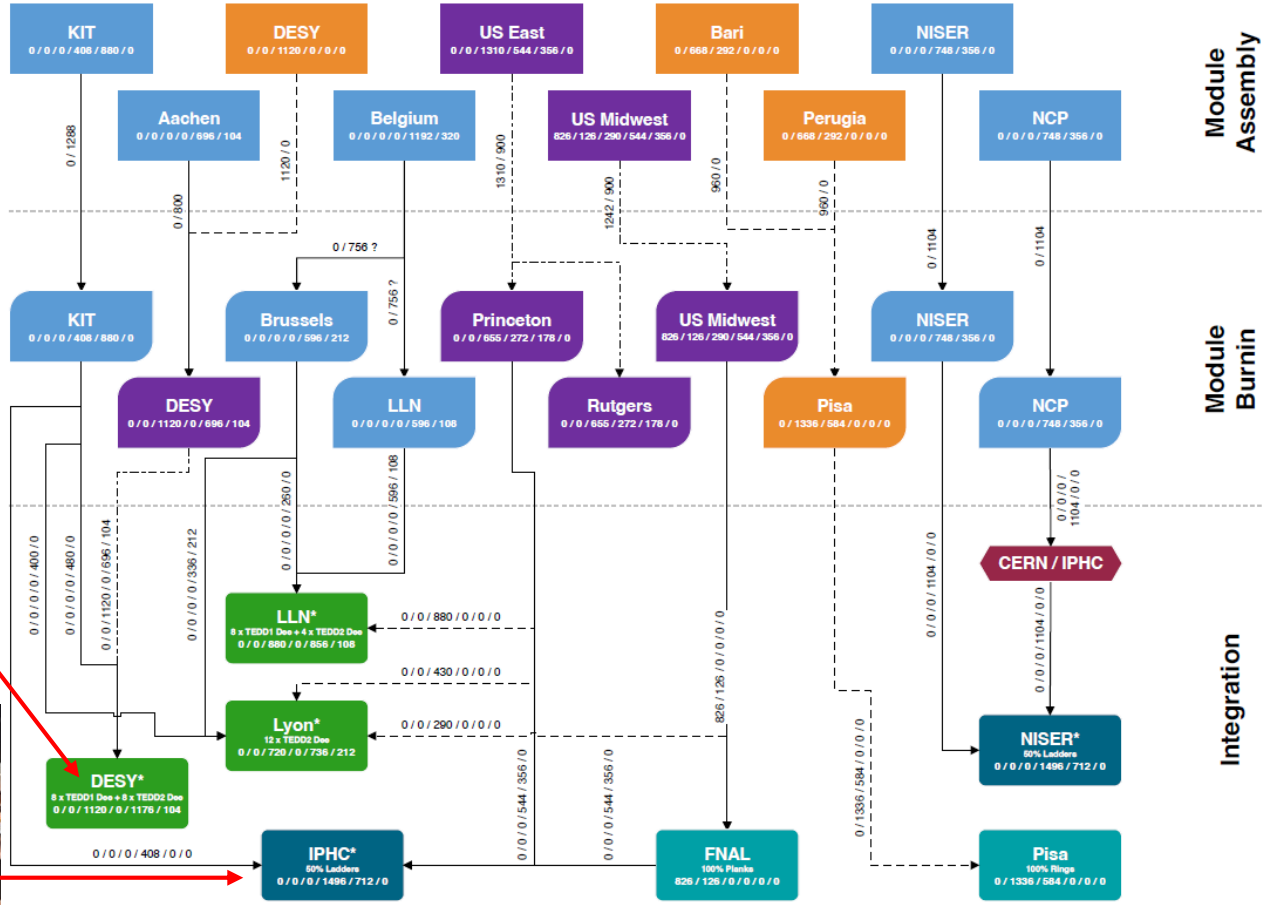
6. Encapsulate wire-bonds



- Module test

Production Flow





Module type list: 1.6 mm PS / 2.6 mm PS / 4.0 mm PS / 1.8 mm 2S 5CP / 1.8 mm 2S 6CP / 4.0 mm 2S

* Integration centers requiring setup for quick module reception tests

2S | PS | 2S & PS | TBPS | TB2S | TEDD

ORGANIZATION

Recap

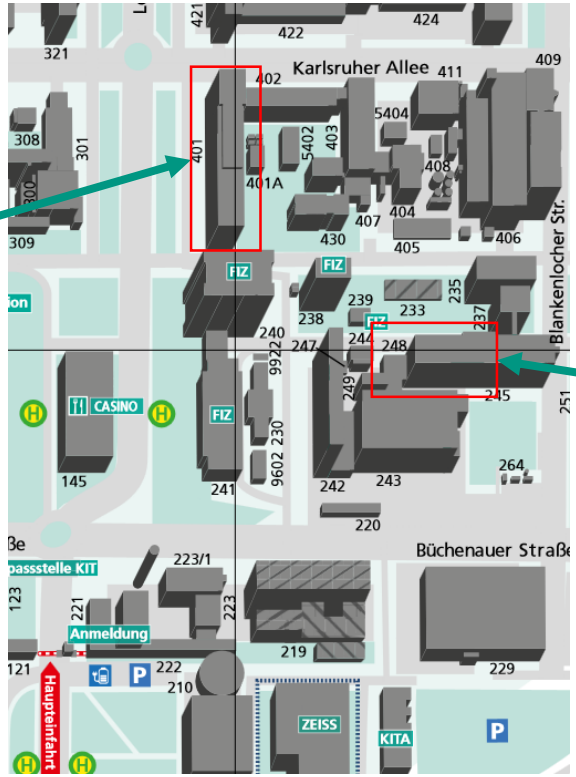
- One of our main task in the ETP hardware group is the contribution to the construction of the Phase-2 Outer Tracker (OT)
- We have a leading role in the silicon sensor R&D and QC
- We have a leading role in the development of test and assembly procedures for 2S Modules
  - In 2016 we pledged to build up to **2000** 2S Modules within 2 years (400 working days)
  - Involves the grant for two technicians, two PHDs and two PostDocs by BMBF
- Mean production rate: **4 modules/day with 6 modules/day at peak**
  - Technically, we can boost the productionline up to 8 modules/day but we are most likely limited by staff

2S Module Workshop at ETP 2022

Organizational Points

- Ulrich, Alexander and myself form the coordination team
  - In case you need to take a sick leave, please ensure that at least one of us is informed
- CernBox folder containing most of the relevant information: https://cernbox.cern.ch/s/zsPK69Dw8yZZNTH
  - Please bookmark on your institute PC
- Contains:
  - **Shift schedules** (incl. module type assembly plan)
  - Instructions for assembly and front-end usage + THIS Guideline
  - QC Sheets
  - Cleaning log
  - Glue log (When did we open which container)
  - Vacation planning: Have a look at the sheet and please ask first before applying in the SAP system
- E-Mail list cms-2s-module-assembly@lists.kit.edu for announcements

ETP at KIT
Campus North



Main building 401:

- Part reception
- Logistics room
- Burn-In
- Packaging & Shipping
- Spare probe-station
- Spare module test setup
- Spare wire-bonder
- (Climatic chamber)

Hall 245 with clean room

- Full module assembly

After reception and unboxing, module components are brought and stored in clean room 245. After the module is assembled it is moved back to 401 for the burn-in test and shipping

Shift Schedule

- We schedule the task for each person on a weekly basis
- We have tasks that have to be done
  - Once a week / every two weeks (Sensor dicing test, QC Al-CF bridges)
  - Every second / third day (Some module tests / Hybrid VI / Skeleton test)
  - Daily (Gluing and Wire-bonding)
- Skipping a daily task can most likely not be recovered the following days and will result in a production day with an outcome 0 modules, reducing our mean throughput significantly
- At the beginning we will try to do the gluing steps with technicians and testing steps with scientific staff (HiWi, PHDs, Post-Docs)
- Once we become more confident we will start to rotate more through the steps
- The shift schedule document contains a individual time line for each person

Schichtplan_2024_41	Monday		Tuesday		Wednesday		Thursday		Friday	
	Task	Person	Task	Person	Task	Person	Task	Person	Task	Person
8:00 - 9:00	Dicing test	Kai	WB tails	Waldemar	WB tails	Waldemar	WB tails	Waldemar	WB tails	Waldemar
	Dicing test	Waldemar	WB tails	Kai	WB tails	Kai	Metrology	Kai	Metrology	Kai
	Dicing test	Stefan	WB tails	Stefan	WB tails	Stefan				
	Dicing test	Lorena	WB tails	Hans Jürgen	WB tails	Hans Jürgen				
			VI Bridges	Lorena						
9:00 - 10:00	Kapton gluing	Kai	Encapsulate tails	Kai	Encapsulate tails	Kai	Encapsulate tails	Kai	Encapsulate tails	Kai
	Kapton gluing	Waldemar	Encapsulate tails	Stefan	Encapsulate tails	Stefan	HV/IV test	Lea	WB modules	Waldemar
	Kapton gluing	Stefan					HV/IV test	Alexander	WB modules	Hans Jürgen
	Dicing test	Lorena			HV/IV test	Lea	HV/IV test	Umut	HV/IV test	Lea
							HV/IV test	Bogdan	HV/IV test	Niyathi
							HV/IV test	Niyathi		
10:00 - 11:00	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai
	Kapton gluing	Waldemar	Kapton gluing	Stefan	Kapton gluing	Stefan			WB modules	Waldemar
	Kapton gluing	Stefan							WB modules	Hans Jürgen
	Dicing test	Lorena								
11:00 - 12:00	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai
	Kapton gluing	Waldemar	Kapton gluing	Stefan	Kapton gluing	Stefan			VI Bridges	Lorena
	Kapton gluing	Stefan								
	Dicing test	Lorena								
13:00 - 14:00	VI Hybrids	Kai			Bare modules assembly	Kai	Bare modules assembly	Kai	Bare modules assembly	Kai
	VI Hybrids	Waldemar			Bare modules assembly	Waldemar			Encapsulate modules	Waldemar
	VI Hybrids	Stefan							Encapsulate modules	Stefan
	VI Hybrids	Tobias								
14:00 - 15:00	VI Hybrids	Kai			Bare modules assembly	Kai	Bare modules assembly	Kai	Bare modules assembly	Kai
	VI Hybrids	Waldemar			Bare modules assembly	Waldemar			Encapsulate modules	Waldemar
	VI Hybrids	Stefan							Encapsulate modules	Stefan
	VI Hybrids	Tobias								
15:00 - 16:00	VI Bridges	Kai					Hybrid gluing	Kai	Hybrid gluing	Kai
	VI Bridges	Waldemar					Hybrid gluing	Stefan		
	VI Bridges	Stefan								
	VI Bridges	Tobias								
16:00 - 17:00	VI Bridges	Kai					Hybrid gluing	Kai	Hybrid gluing	Kai
	VI Bridges	Waldemar					Hybrid gluing	Stefan		
	VI Bridges	Stefan								
	VI Bridges	Tobias								

Personalized Schedules

Kai	Montag	Dienstag	Mittwoch	Donnerstag	Freitag
8:00 - 9:00	Metrology	Metrology	Metrology	Metrology	Metrology
9:00 - 10:00	Encapsulate tails	Encapsulate tails	Encapsulate tails	Encapsulate tails	
10:00 - 11:00	Kapton gluing	Kapton gluing	Kapton gluing	WB modules	WB modules
11:00 - 12:00	Kapton gluing	Kapton gluing	Kapton gluing	Test modules before encaps.	Test modules before encaps.
13:00 - 14:00	Bare modules assembly	Bare modules assembly	Bare modules assembly	Bare modules assembly	Bare modules assembly
14:00 - 15:00	Bare modules assembly	Bare modules assembly	Bare modules assembly	Bare modules assembly	Bare modules assembly
15:00 - 16:00	Hybrid gluing	Hybrid gluing	Hybrid gluing	Hybrid gluing	Hybrid gluing
16:00 - 17:00	Hybrid gluing	Hybrid gluing	Hybrid gluing	Hybrid gluing	Hybrid gluing

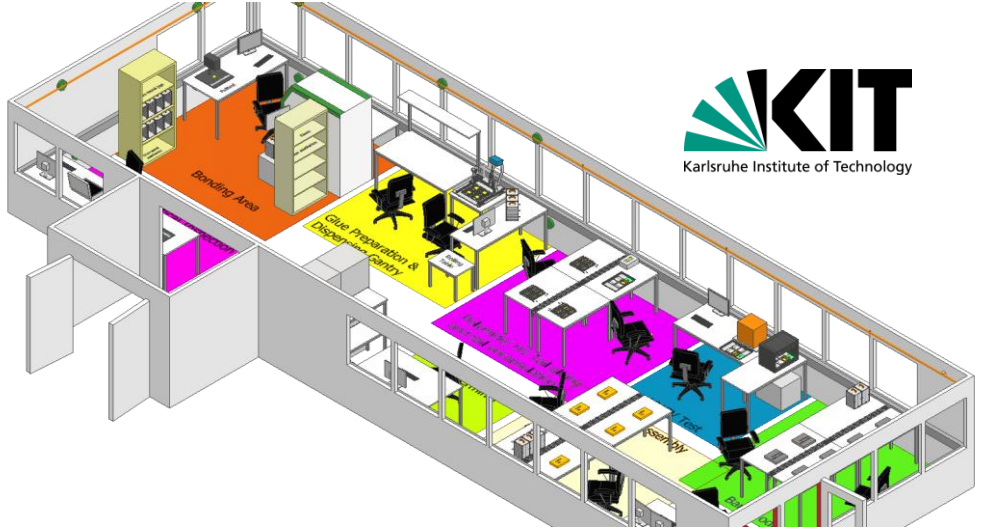
Shift Schedule Granularity

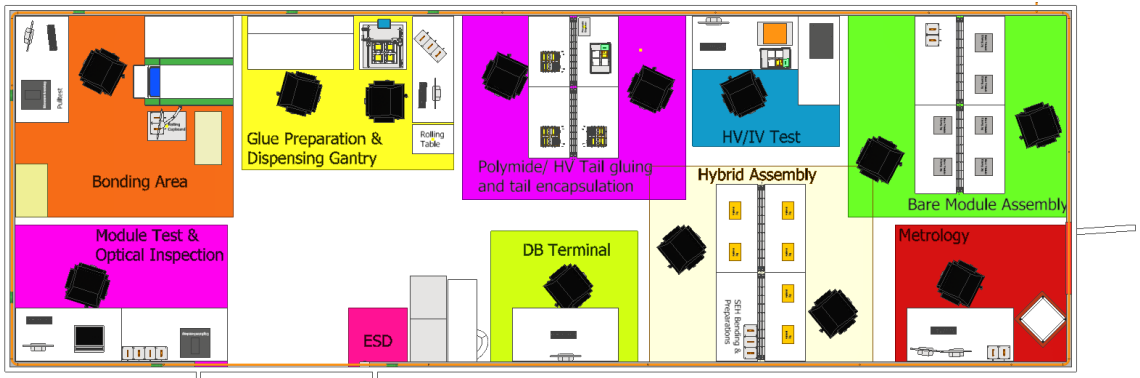
- Do not take the times too serious, it is not straight forward to put everything into one big table
  - By design, each person would do 2.5 extra hours per week, not sustainable
  - We might adapt the times as soon as we have some experience, which can only be made once we have a situation in which each task is only done by one person
- Assembling the modules comes with a lot of steps
  - Not all task can be depicted in the shift schedule
  - Whenever you are done with your task, take a break, refresh yourself and afterwards check what you can do elsewhere or whom you can support; You can
    - VI hybrids
    - VI bridges
    - Assemble skeletons
    - Dicing tests
    - Assemble carriers
    - …
- In a full production scenario there will be max 2 gluing/assembly tasks per day per person
  - 1 in the morning, 1 in the afternoon
- Building 1 module / day it takes 7 days to be done. Building multiple modules / day this will change to 10-11 days to have less constraints in the testing and assembly sequence

Clean Room 245

- ~100 m²
- ISO class 7
- Pressurized air ring line
- Vacuum ring line
- ESD-safe floor
- 2024: Inauguration

- **You need to have access to building 245 with your KIT card**
  - Contact Fr. Schäfer or Fr. Chen
- It is a clean room: Please keep your drinks and snacks outside



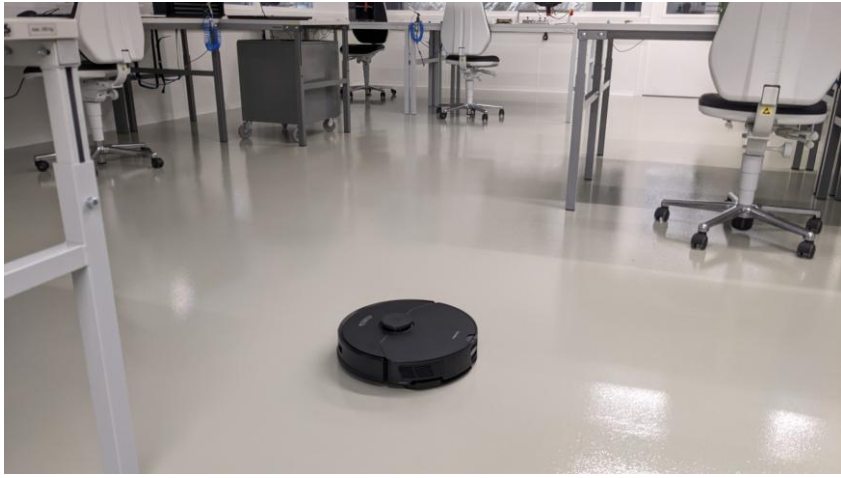


Entering the Clean Room – Air Lock

- Please leave your jackets / rain coats **outside** the air lock
  - Put in one of the lockers or hang on TV holder
  - We will install a coatrack outside soon
- Put on hair net, clean room coat and get your mask
  - Each long-term member should already have his own, labelled coat
  - If you want you can use the same hair net and masks multiple times (not essential)
  - You can keep your sweater on the same hook from which you took the coat
  - We still have to come up on how to clean the coats
    (most probably one of us will take a bunch home and wash them
- Shoes
  - Put your street shoes on the shelves at the outer side
  - Each long-term member should already have ESD-safe “clean room shoes” (Birkenstock)
    - If you do not have shoes already, put on the blue over shoes and put the strap IN your sock
  - Mark them with your name and always store them in the shelve labelled with your name
  - Avoid taking the wrong shoes
- After entering: Check ESD-connection to the floor! (No charge-up while walking around)

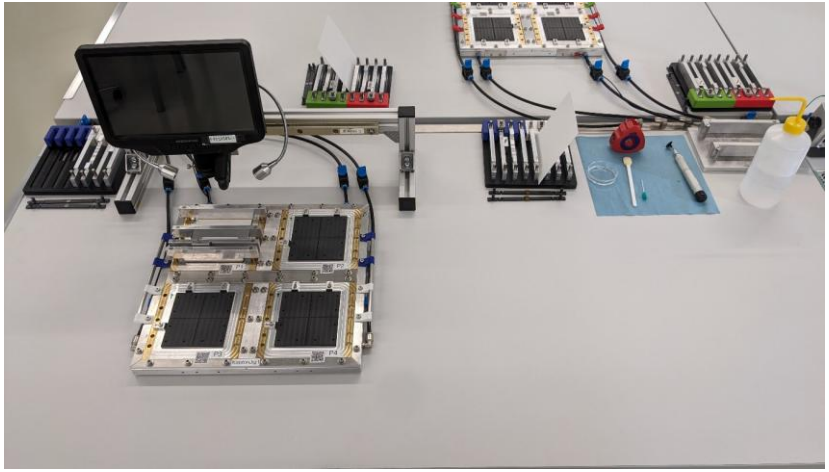
Keeping the Clean Room clean

- Please do not bring cardboard boxes inside the clean room
- We do have a cleaning robot (Reiner / Robby / Obi Wan Cleanobi)
  - Cleans (vac. cleaning & wiping) each Thursday evening (8pm – 10pm)
  - Requires water change on Friday morning
    - We are using decalcified water for re-fill
  - Interval might increase once we are at full pace
- In times of low productivity (e.g. missing components) we will also do a manual cleaning of all surfaces
  - There is a “Reiningungsplan” in the CernBox for documentation
- Only things relevant to the production should stay inside the clean room
  - As we are still rearranging stuff, this is not yet 100% true, but new stuff brought into the room should always be questioned
- Please empty the trash bins regularly
  - “Endless bag” system
- Remove packaging material and put it into the trash next to building 401



Keep the Working Space organized

- You might not be the person doing the same task the following day
- After the task is done, put the tools were they are supposed to be
  - We will decide together what to place where and then make example images on how to leave each working space
- Clean your tools (Epoxy resin)
- Communicate, when we should change things (more, other tools etc)



Visitors

- Being the hardware flag-ship, we will have plenty of visitors during the next two years
  - There are nice posters outside the clean room to introduce the topic (1 in German)
- There are disposable clean room coats and over-shoes available
- Please ensure that all visitors wear them (incl. hair nets)
- Within the clean room:
  - Only looking, everything is kept were it is
  - Worst case: Jigs are moved, tools are not were they are supposed to be.
    Big No No!
  - Some work requires quite some concentration. If people seem to be very busy, do not interrupt them
- We will prepare some hands-on stuff to show around:
  Broken sensors, bridges, hybrids

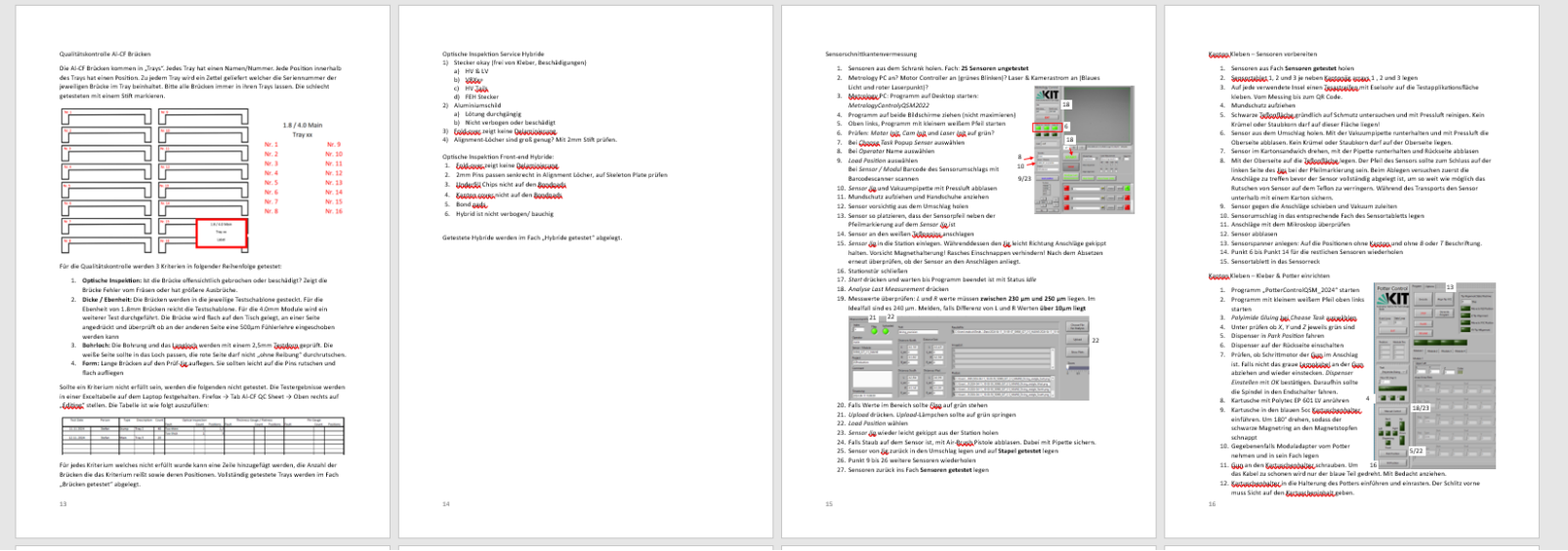
Breaks

- There is a small office in 245 used by our IAP colleagues (‘Mo’, Heiko) that could be used for breaks
  - Chairs, desks…
  - On the way to the restrooms (you must bring your access card)
- Not yet requested from our side
  - If people want to drink a coffee we might need to setup a second coffee machine / “Kaffeekasse”

KIT 2S MODULE ASSEMBLY LINE

ETP Assembly Document

- Also located in the CernBox folder
- General overview of assembly line
- Step by step instructions for all tasks
- Homework 1: Read it!



Qualitätskontrolle Al-CF Brücken

Die Al-CF Brücken kommen in „Trays". Jedes Tray hat einen Namen/Nummer. Jede Position innerhalb des Trays hat einen Position. Zu jedem Tray wird ein Zettel geliefert welcher die Seriennummer der jeweiligen Brücke im Tray beinhaltet. Bitte alle Brücken immer in ihren Trays lassen. Die schlecht getesteten mit einem Stift markieren.

1.8 / 4.0 Main Tray xx

Nr. 1	Nr. 9
Nr. 2	Nr. 10
Nr. 3	Nr. 11
Nr. 4	Nr. 12
Nr. 5	Nr. 13
Nr. 6	Nr. 14
Nr. 7	Nr. 15
Nr. 8	Nr. 16

Für die Qualitätskontrolle werden 3 Kriterien in folgender Reihenfolge getestet:

1. **Optische Inspektion:** Ist die Brücke offensichtlich gebrochen oder beschädigt? Zeigt die Brücke Fehler vom Fräsen oder hat größere Ausbrüche.
2. **Dicke / Ebenheit:** Die Brücken werden in die jeweilige Testschablone gesteckt. Für die Ebenheit von 1.8mm Brücken reicht die Testschablone. Für die 4.0mm Module wird ein weiterer Test durchgeführt. Die Brücke wird flach auf den Tisch gelegt, an einer Seite angedrückt und überprüft ob an der anderen Seite eine 500µm Fühlerlehre eingeschoben werden kann.
3. **Bohrloch:** Die Bohrung und das Loctitech werden mit einem 2,5mm Testdorn geprüft. Die weiße Seite sollte in das Loch passen, die rote Seite darf nicht „ohne Reibung" durchrutschen.
4. **Form:** Lange Brücken auf dem Prüf- ist auflegen. Sie sollten leicht auf die Pins rutschen und flach aufliegen

Sollte ein Kriterium nicht erfüllt sein, werden die folgenden nicht getestet. Die Testergebnisse werden in einer Exceltabelle auf dem Laptop festgehalten. Firefox → Tab Al-CF QC Sheet → Oben rechts auf „Edition" stellen. Die Tabelle ist wie folgt auszufüllen:

Für jedes Kriterium welches nicht erfüllt wurde kann eine Zeile hinzugefügt werden, die Anzahl der Brücken die das Kriterium reißt sowie deren Positionen. Vollständig getestete Trays werden im Fach „Brücken getestet" abgelegt.

13

Optische Inspektion Service Hybride

1) Stecker okay (frei von Kleber, Beschädigungen)
   a) HV & LV
   b) NTC
   c) HV Pads
   d) FEH Stecker
2) Aluminiumschild
   a) Lötung durchgängig
   b) Nicht verbogen oder beschädigt
3) Kapton zeigt keine Delaminierung
4) Alignment-Löcher sind groß genug? Mit 2mm Stift prüfen.

Optische Inspektion Front-end Hybride:

1. Kapton zeigt keine Delaminierung
2. 2mm Pins passen senkrecht in Alignment Löcher, auf Skeleton Plate prüfen
3. Underfill Chips nicht auf den Bondpads
4. Kapton evtl. nicht auf den Bondpads
5. Bond okay
6. Hybrid ist nicht verbogen/ bauchig

Getestete Hybride werden im Fach „Hybride getestet" abgelegt.

14

Sensorschnittantenvermessung

1. Sensoren aus dem Schrank holen. Fach: **25 Sensoren ungetestet**
2. Metrology PC an? Motor Controller an (grünes Blinken)? Laser & Kamerastrom an (Blaues Licht und roter Laserpunkt)?
3. Messung PC: Programm auf Desktop starten: *MetrologyControlQSM2022*
4. Programm auf beide Bildschirme ziehen (nicht maximieren)
5. Oben links, Programm mit kleinem weißem Pfeil starten
6. Prüfen: Motor on, Cam out und Laser out auf grün?
7. Bei Choose Task Popup Sensor auswählen
8. Bei *Operator* Name auswählen
9. *Load Position* auswählen
   Bei *Sensor / Modul* Barcode des Sensorumschlags mit Barcodescanner scannen
10. *Sensor on* und Vakuumpipette mit Pressluft ablasen
11. Mundschutz aufsiehen und Handschuhe anziehen
12. Sensor vorsichtig aus dem Umschlag holen
13. Sensor so platzieren, dass der Sensorpfeil neben der Pfeilmarkierung auf dem Sensor *on* ist
14. Sensor an den weißen Teflonstop anschlagen
15. *Sensor on* in die Station einlegen. Währenddessen den *on* leicht Richtung Anschläge gekippt halten. Vorsicht Magnethalterung! Rasches Einschnappen verhindern! Nach dem Absetzen erneut überprüfen, ob der Sensor an den Anschlägen anliegt.
16. Stationstür schließen
17. *Start* drücken und warten bis Programm beendet ist mit Status *Idle*
18. *Analyse Last Measurement* drücken
19. Messwerte überprüfen: *L and R* werte müssen **zwischen 230 µm und 250 µm** liegen. Im Idealfall sind es 240 µm. Melden, falls Differenz von L und R Werten **über 10µm liegt**
20. Falls Werte im Bereich sollte Gap auf grün stehen
21. *Upload* drücken. Upload-Lämpchen sollte auf grün springen
22. *Load Position* wählen
23. *Sensor on* wieder leicht gekippt aus der Station holen
24. Falls Staub auf dem Sensor ist, mit Air-Brush Pistole ablasen. Dabei mit Pipette sichern.
25. Sensor von on zurück in den Umschlag legen und auf **Stapel getestet** legen
26. Punkt 9 bis 26 weitere Sensoren wiederholen
27. Sensoren zurück ins Fach **Sensoren getestet** legen

15

Kapton Kleben – Sensoren vorbereiten

1. Sensoren aus Fach **Sensoren getestet** holen
2. Sensortablett 1, 2 und 3 je neben Kapton essen 1 , 2 und 3 legen
3. Auf jede verwendete Insel einen Sensorstecker mit Exelsior auf die Testapplikationsfläche kleben. Vom Messing bis zum QR Code.
4. Mundschutz aufziehen
5. Schwarze Teflonfläche gründlich auf Schmutz untersuchen und mit Pressluft reinigen. Kein Krümel oder Staubkorn darf auf dieser Fläche liegen!
6. Sensor aus dem Umschlag holen. Mit der Vakuumpipette runterhalten und mit Pressluft die Oberseite ablasen. Kein Krümel oder Staubkorn darf auf der Oberseite liegen.
7. Sensor im Kartonsandwich drehen, mit der Pipette runterhalten und Rückseite ablasen
8. Mit der Oberseite auf die Teflonfläche legen. Der Pfeil des Sensors sollte zum Schluss auf der linken Seite des Jig bei der Pfeilmarkierung sein. Beim Ablegen versuchen zuerst die Anschläge zu treffen bevor der Sensor vollständig abgelegt ist, um so weit wie möglich das Rutschen von Sensor auf dem Teflon zu verringern. Während des Transports den Sensor unterhalb mit einem Karton sichern.
9. Sensor gegen die Anschläge schieben und Vakuum zuleiten
10. Sensorumschlag in das entsprechende Fach des Sensortablets legen
11. Anschläge mit dem Mikroskop überprüfen
12. Sensor ablasen
13. Sensorspanner anlegen: Auf die Positionen ohne Kapton und ohne *B* oder *T* Beschriftung.
14. Punkt 6 bis Punkt 14 für die restlichen Sensoren wiederholen
15. Sensortablett in das Sensorreck

Kapton Kleben – Kleber & Potter einrichten

1. Programm „PotterControlQSM_2024" starten
2. Programm mit kleinem weißem Pfeil oben links starten
3. *Polyimide Gluing* bei *Choose Task* auswählen
4. Unter prüfen ob X, Y und Z jeweils grün sind
5. Dispenser in *Park Position* fahren
6. Dispenser auf der Rückseite einschalten
7. Prüfen, ob Schrittmotor der Gap im Anschlag ist. Falls nicht das graue Verbindet an der Gap abziehen und wieder einstecken. *Dispenser Einstellen* mit *OK* bestätigen. Daraufhin sollte die Spindel in den Endschalter fahren.
8. Kartusche mit Polytec EP 601 LV anrühren
9. Kartusche in den blauen Sockel Kartuschenhalter einführen. Um 180° drehen, sodass der schwarze Magnetring an den Magnetstopfen schnappt
10. Gegebenenfalls Moduladapter vom Potter nehmen und in sein Fach legen
11. Gap an den Kartuschenhalter schrauben. Um das Kabel zu schonen wird nur der blaue Teil gedreht. Mit Bedacht anziehen.
12. Kartuschenhalter in die Halterung des Potters einführen und einrasten. Der Schlitz vorne muss Sicht auf den farbigen Ventilkopf geben.

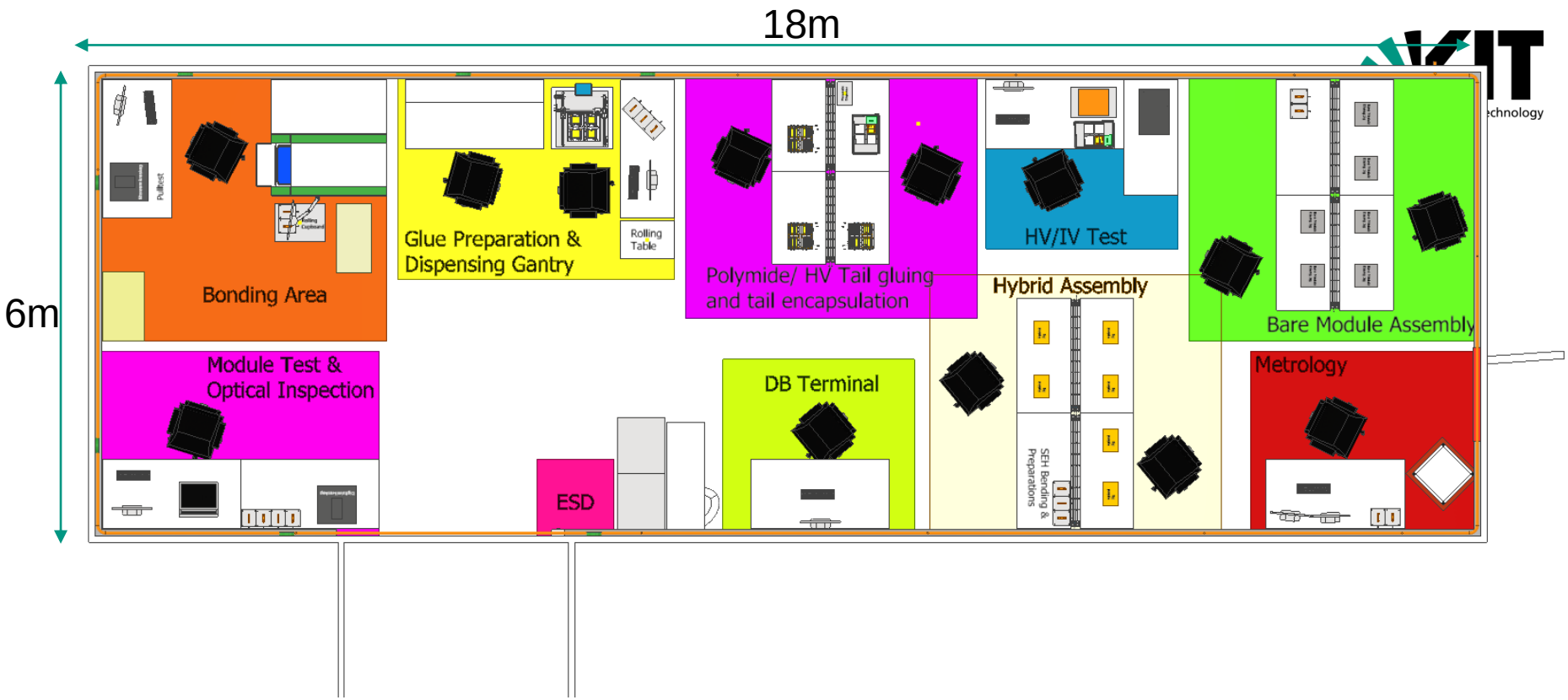
16

Part Reception

- Parts and empty transport boxes come in → Modules (“of the highest quality”) go out
- Dedicated logistics room planned (401 “old probe lab”)
- Coordination team: Mark the shipment in the CMS DB to RECEIVED
- We also track each component with our DB
- For mass injection we have simple program that uses the input coming from the barcode of the parts
- Depending on the available storage capacity components are then moved to the clean room

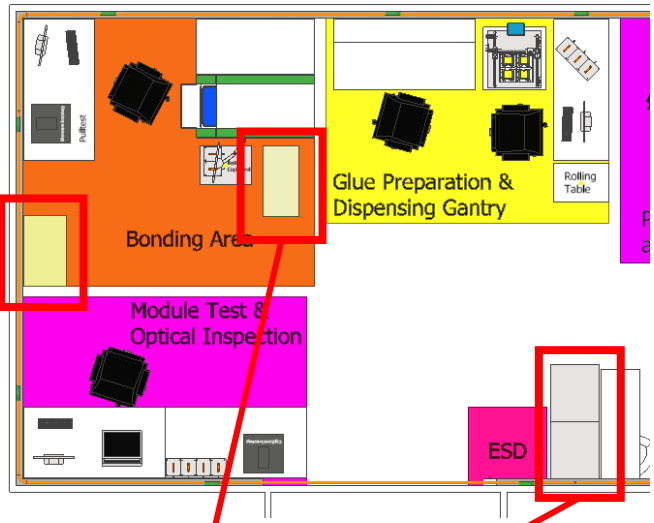
Parts overview:

structure	Count	Assembled	Available
2S_Sensor	3522	54	3468
2S_Skeleton	22	16	6
Al_cf_bridge_long_18	270	36	195
Al_cf_bridge_long_40	198	2	182
Al_cf_bridge_short_18	339	28	285
Al_cf_bridge_short_40	178	2	171
fehybrid_left	64	24	40
fehybrid_right	69	26	43
gnd_balancer	119	9	110
hvtail_bottom	46	31	15
hvtail_top	45	30	15
kapton_long	556	90	465
kapton_short	540	73	467
service_hybrid	101	24	77
VTRxPlus	118	9	109


18m
6m
Bonding Area
Glue Preparation &
Dispensing Gantry
Rolling
Table
Polymide/ HV Tail gluing
and tail encapsulation
HV/IV Test
Hybrid Assembly
Bare Module Assembly
Module Test &
Optical Inspection
DB Terminal
Metrology
ESD
SEH Bending &
Preparations

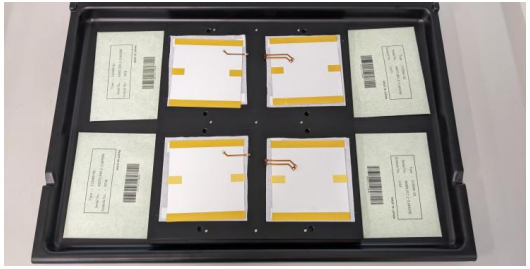
Storage

- 3 Storage cabinets: All flushed with dry air
- #1 Component reception
  - Store FEHs, SEHs, Bridges when they arrive
  - 1 Shelf for each:
    - Tested components
    - Untested components
  - Spare jigs, clean room auxiliaries
- #2 Dispensing and clean room supplies
  - Gloves, masks, tissues, dispensing tips, cartridges, Petri dishes, glues ….
  - Broken pieces
- #3 Wire-bonding and module cupboard
  - Wire-bonding jigs and auxiliaries
  - Final module storage before moved to burn-in in another building



Intermediate Storage and Component Travel

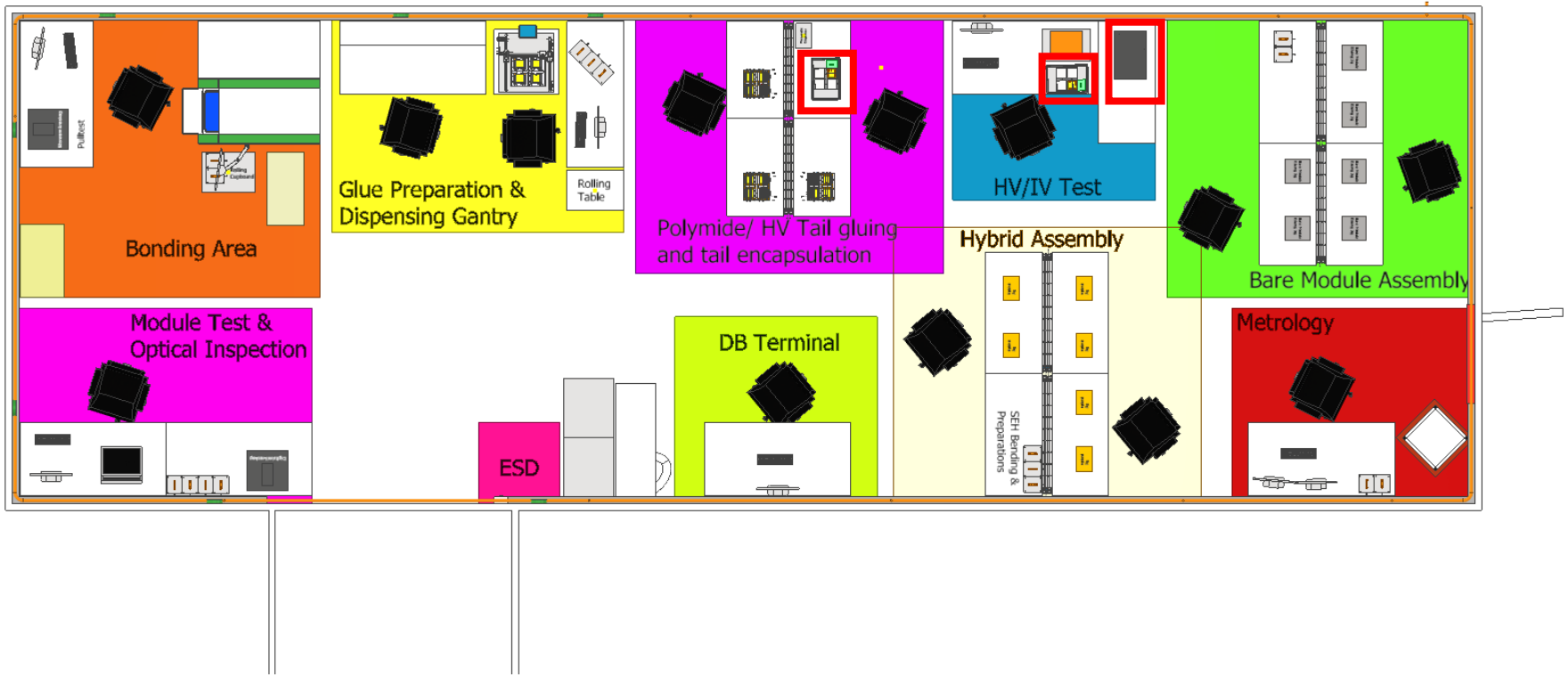
- Between assembly steps parts must travel from one table to another
- We designed dedicated transportation and intermediate storage vessels
  - **Sensor tablet**



Module cassette

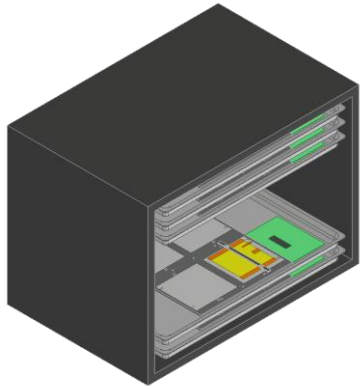
- One of the first thing to do in the morning:
  Rotate cassette from yesterday's to today's task

Sensor tablets

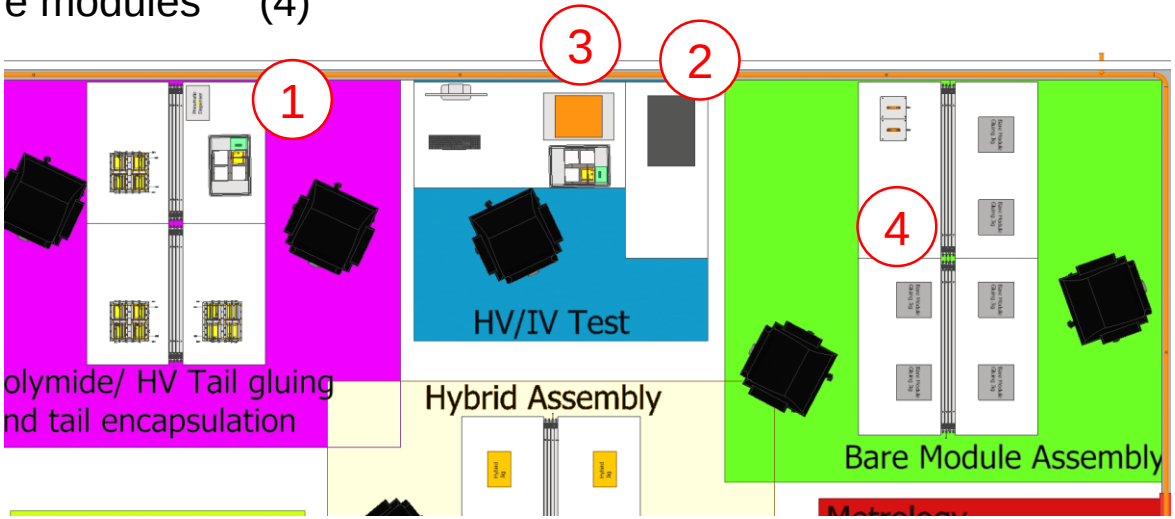


Sensor Tablets

- Apply encapsulation on HV bonds (1)
- Store sensors in tablet rack (2)
- HV/IV test (3)
- Take sensors to assemble bare modules (4)



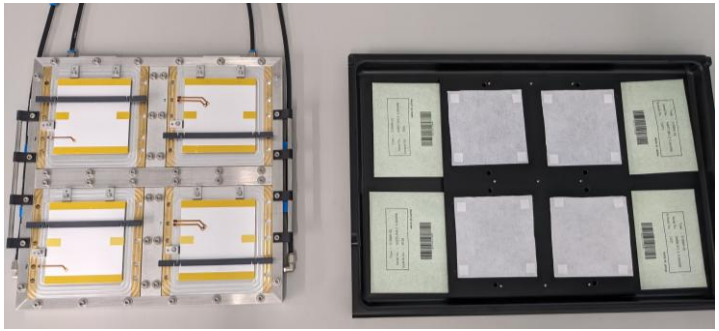
Tablet rack



Sensor Tablets

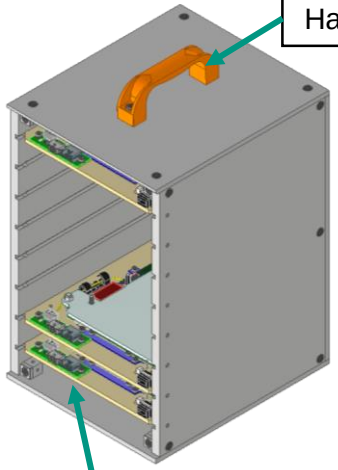
- After wire-bonding the sensors will be removed from the gluing jig and put on the sensor tablet for encapsulation (pneumatic dispenser) & HV/IV test
- 1 Tablet stores up to 4 sensors
  - Sensor envelopes fixated with pressure pins below
  - Sensors a fixated with clamps (not shown in the picture)
- 3 Tablets directly linked to sensors on Kapton gluing jigs
  - Ensures not to lose track of sensor ID!
- 12 Tablets available
  - Placed in a rack
  - Rack could be extended with an additional shield to flush it with dried air
- Content of tablet is indicated with a magnetic label (Curing, To be tested, Done, …)

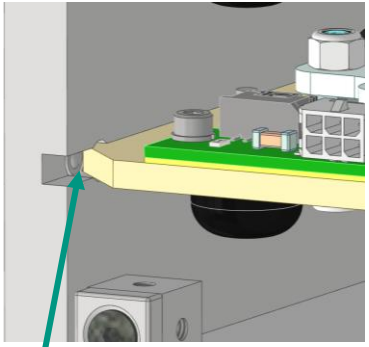
→ 48 sensors can be stored on long-term

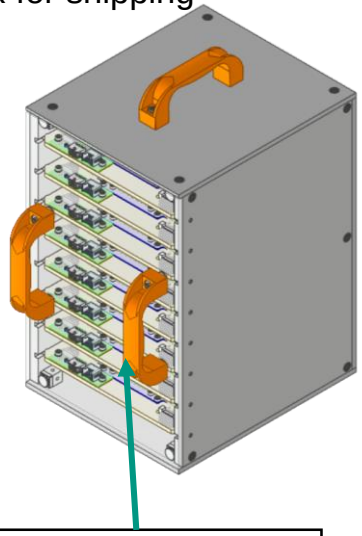


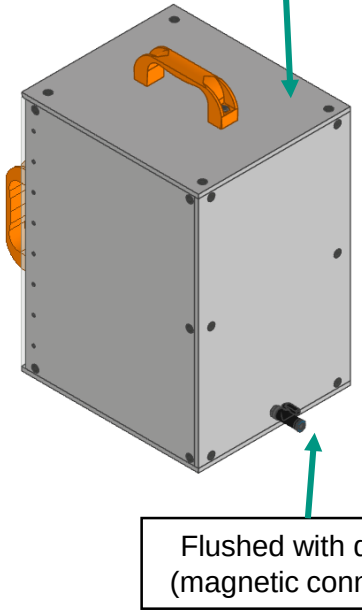
Module Cassette

- Transport unit between assembly steps **and** buildings
  - Contains up to 8 modules
  - First time used for bare modules on carriers
  - Emptied when modules are moved to transport box for shipping



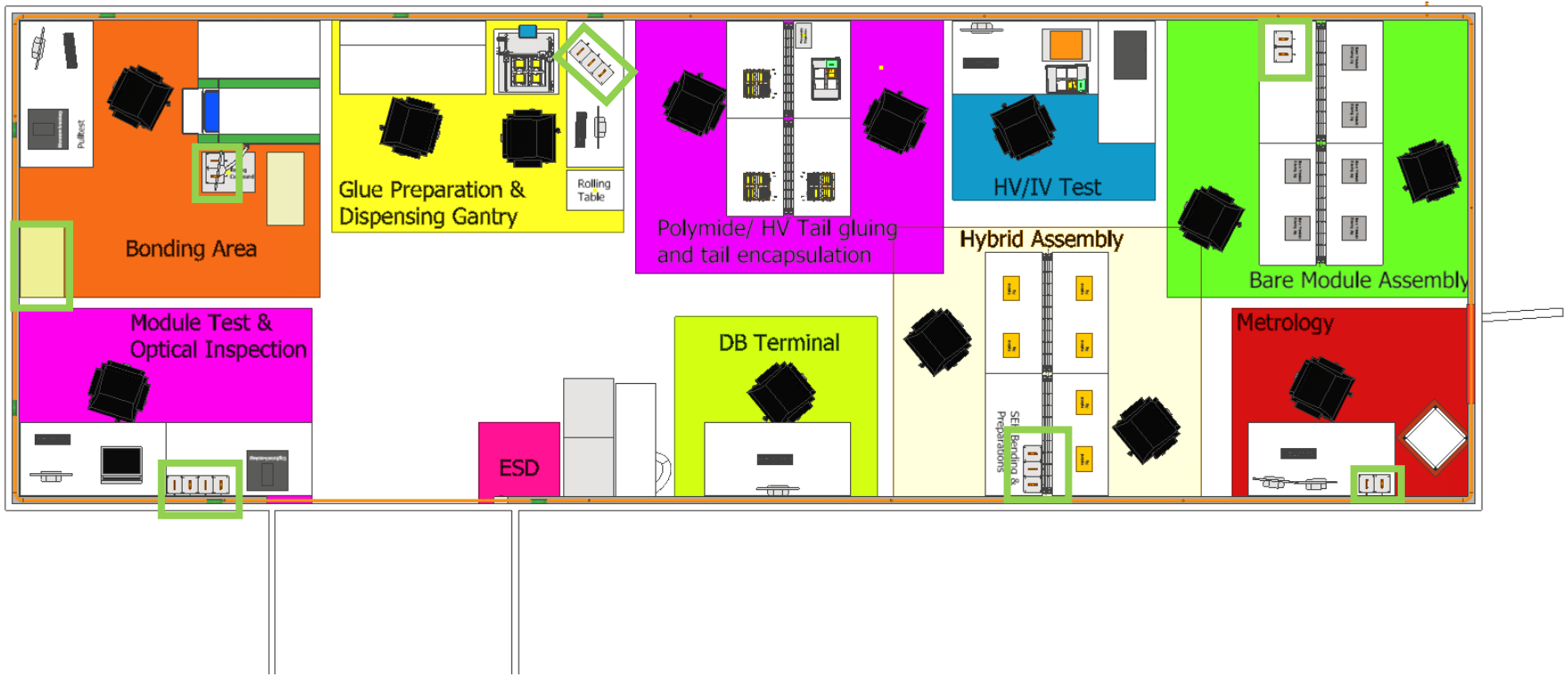






Always check that the connector is properly attached!

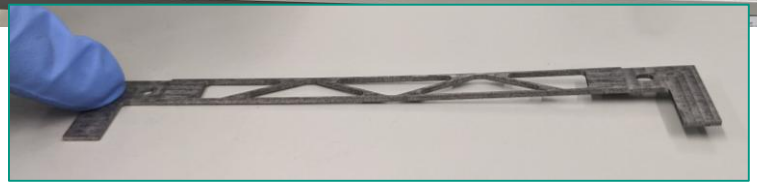
Module cassettes



Visual Inspection / Skeleton Assembly

- One dedicated desk with a stereo microscope to visually inspect hybrids, bridges and to assemble skeletons
- Hybrid VI entered into DB via Front-end (Laptop available)
- Hybrids: We search for obvious damages on the hybrids:
  - Delamination
  - Broken connectors
  - Significant dirt on the wire-bond pads

  Do not take too much time for this!
- Bridges: 4 checks:
  - Broken
  - Thickness
  - Flatness
  - Hole diameter
- Checked hybrids and bridges moved into the “tested” cabinet
- After the assembly of skeletons they are stored on skeleton plates in module cassettes
- Hybrid & Bridge VI: Perfect task that can be done if you have some time left over

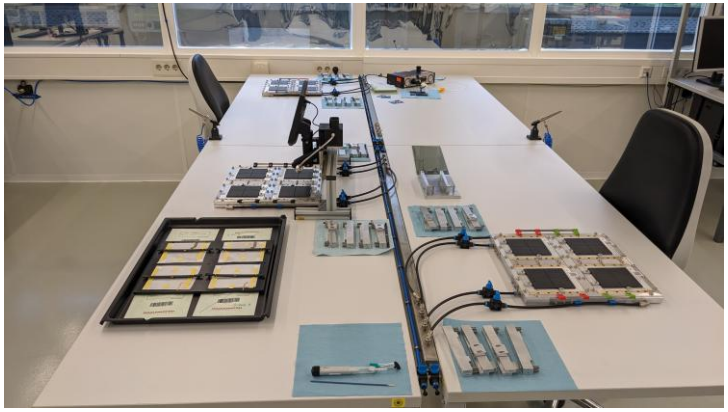


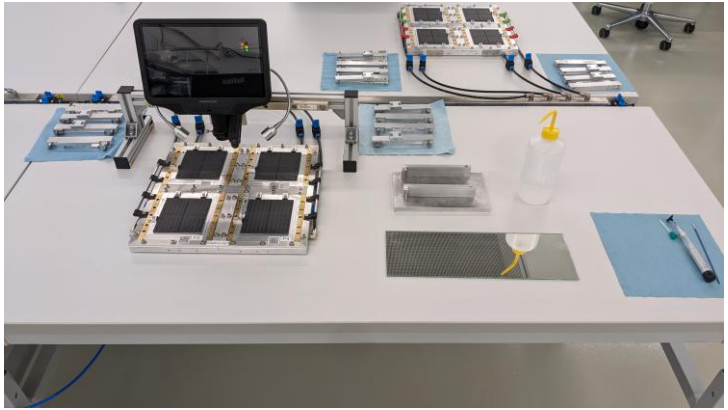
Gluing Stations

- Gluing will happen on “gluing stations” made out of 4 desks each. 3 of those desks host jigs to glue parts for 2 modules
  → 6 Modules / day
- Each stations comes with an integrated vacuum and dry air supply
  → Modular arrangement
- Each gluing station has a battery-powered portable digital microscope
- Microscopes do have certain focus setting:
  Do not move them
  from one station to the other!
- After your shift:
  Put the batteries
  back in to the charger!

Polyimide Gluing Station

- In total 3 jigs à 4 sensors
- 4th table to for HV tail encapsulation. Equipped with a pneumatic dispenser
- After sensors are placed their envelopes are stored on a sensor tablet, which is then moved to a rack to leave space for the alignment tools

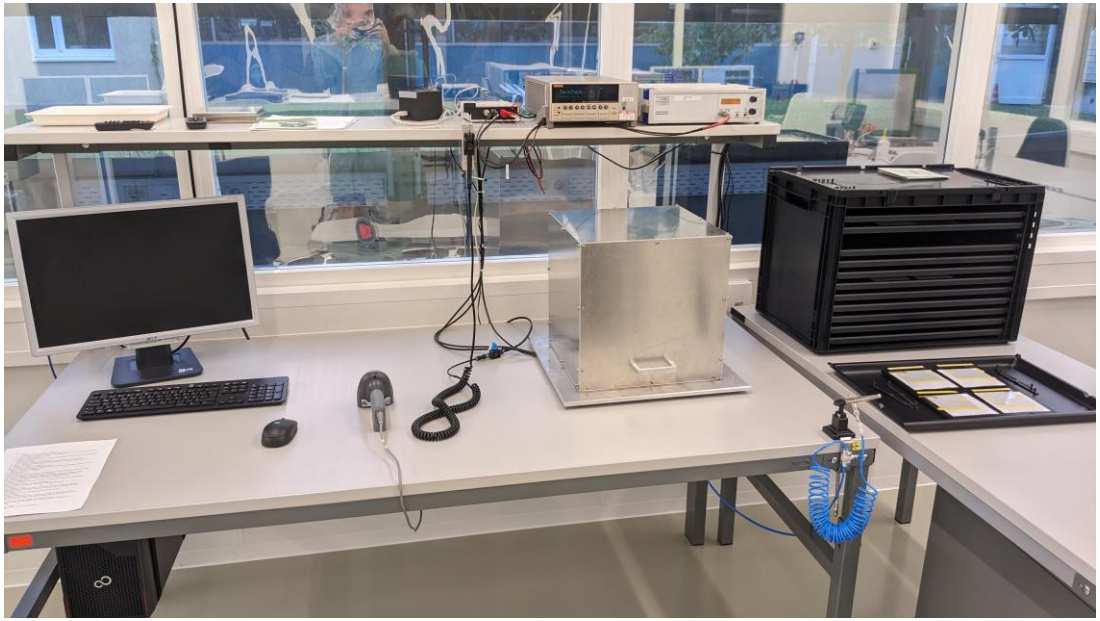




HV / IV Test

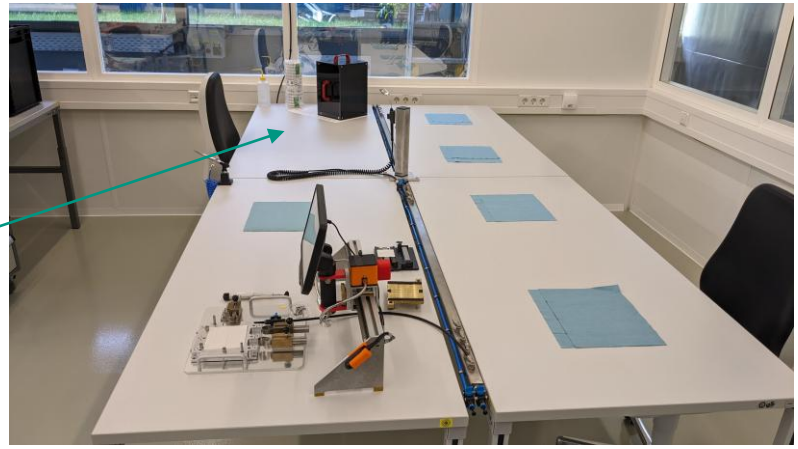
- Test HV stability of Kapton strips
- Measure IV curve of kaptonized sensor

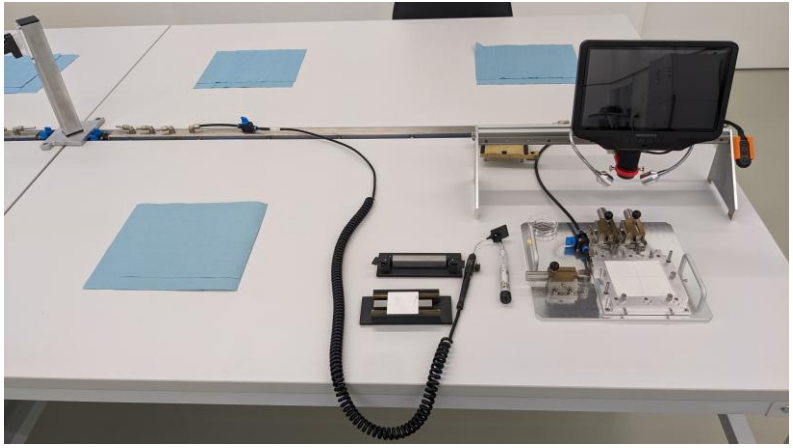
- IV measurement uploaded to local DB and forwarded to CMS construction DB
  - Data forwarded to construction DB on daily basis



Bare Module Gluing Station

- 3 desks with 2 jigs each
- Sensor tablet is placed between two jigs to place sensors
- 4th desk for preparation, carrier labelling and storage





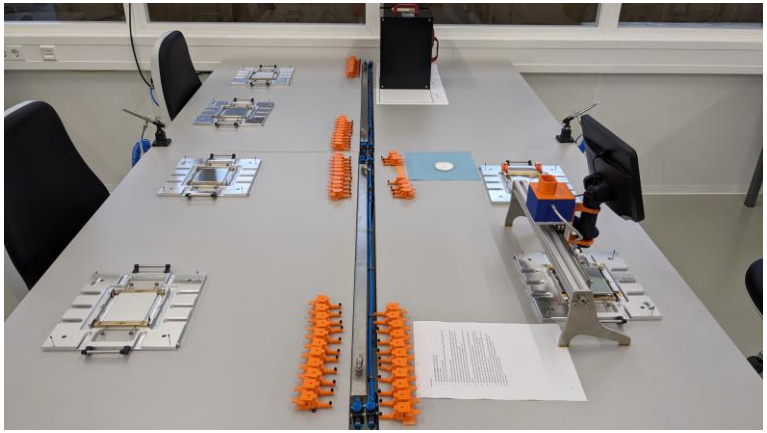
Metrology

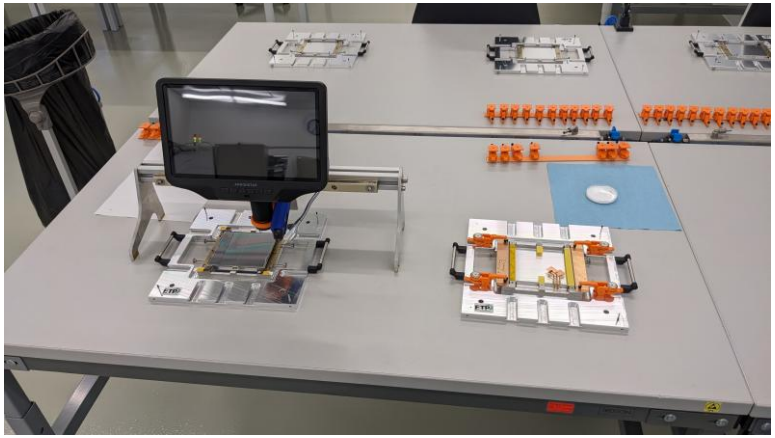
- Measure sensor dicing accuracy
- Edge to edge alignment
- Fusing script generates top strip to bottom strip alignment

- Alignment uploaded to local DB and then forwarded to construction DB
  - Data forwarded to construction DB on daily basis

Hybrid Gluing Station

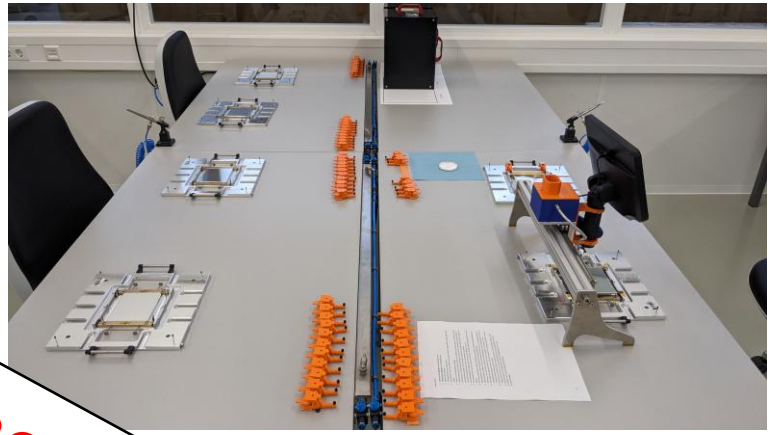
- 3 desks with 2 jigs each
- 4th desk for preparation and storage with 3 module cassettes
  - Skeletons
  - Bare modules
  - Modules
- Jigs will be slightly shifted on the table to free some space for the assembly itself

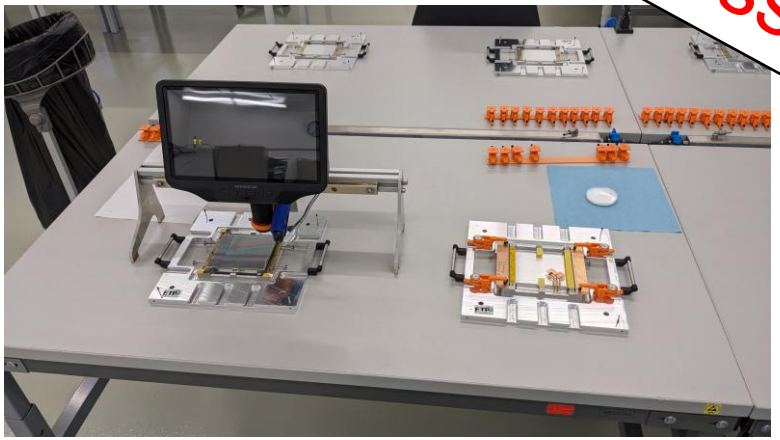




Hybrid Gluing Station

- 3 desks with 2 jigs each
- 4th desk for preparation a… dule cassettes
  - Skeletons
  - Bare modules
  - Modules
- Jigs will be slightly shifted on the table to… space for the assembly itself

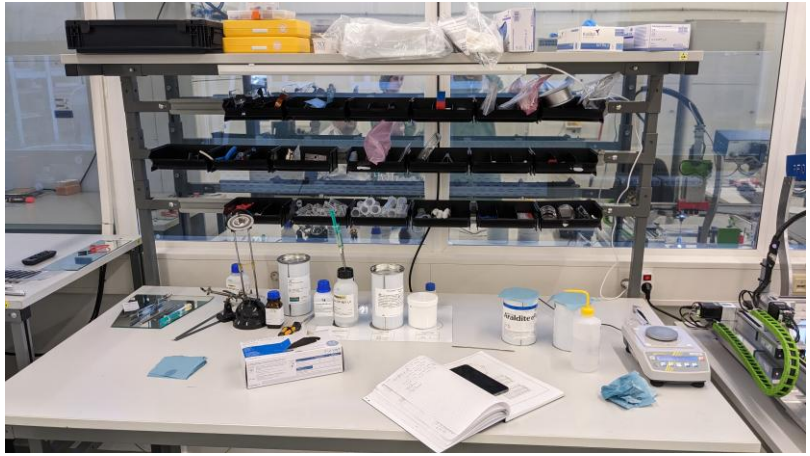




Do not glue the SEH in the upcoming assembly exercise!

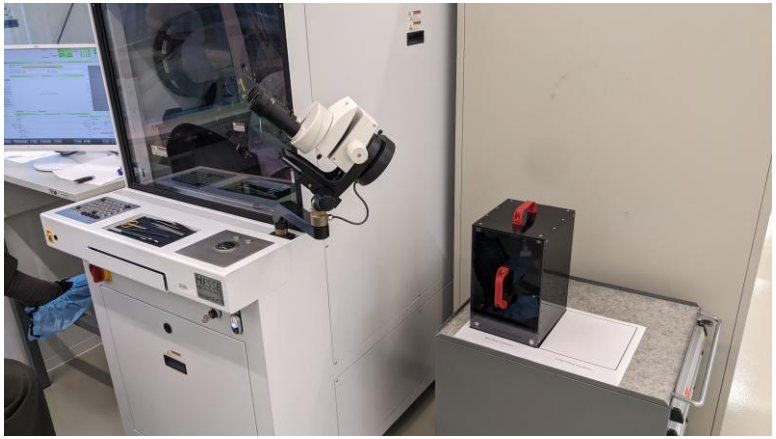
Dispensing Gantry / Glue Preparation

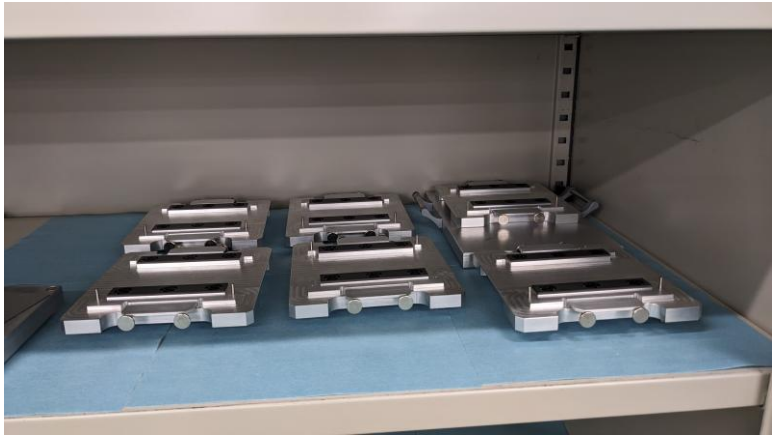
- Custom-made gantry
- Volumetric dispenser (Precifluid)
  - 5cc Gun (Kapton Gluing, Wire-bond encapsulation)
  - 30cc Gun (Wire-bond encapsulation)
- Handles 4 sensors or modules **at once**
- 3 module cassettes to store modules for
  - Not encapsulated
  - Bottom side curing
  - Top side curing
- Keep it clean!



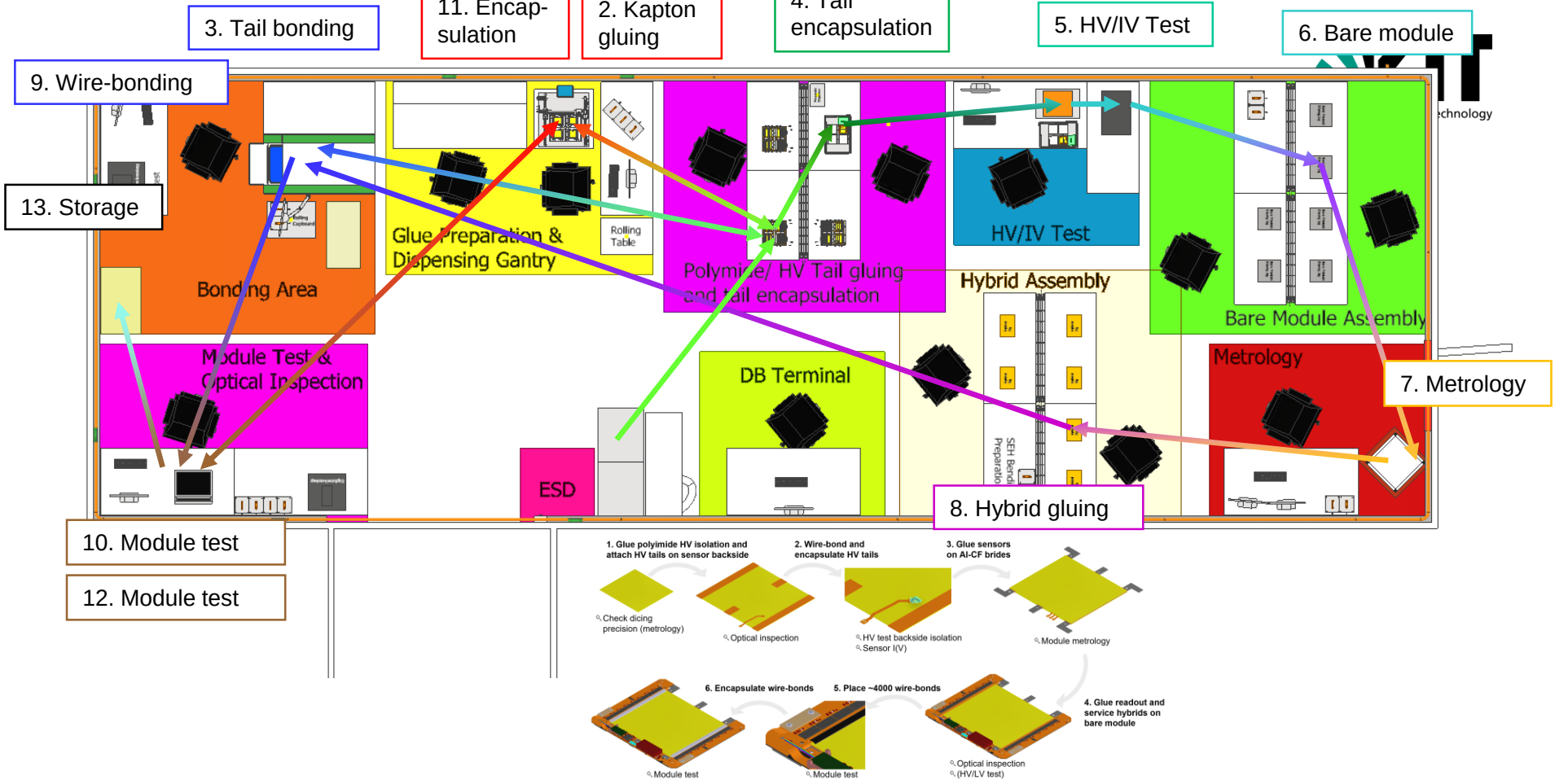
Wire-bonding

- Hesse BJ855 (Backup BJ820 in building 401)
  - Both bonders use the same vacuum table compatible with our wire-bonding jigs
- 2 Module cassettes to store unbonded and bonded modules
- Jigs stored in cupboard nearby
- One extra desk for VI



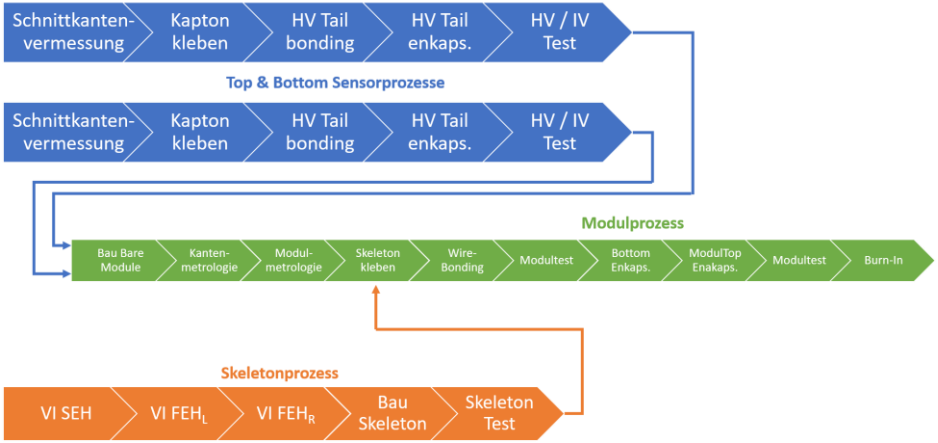


Module Test

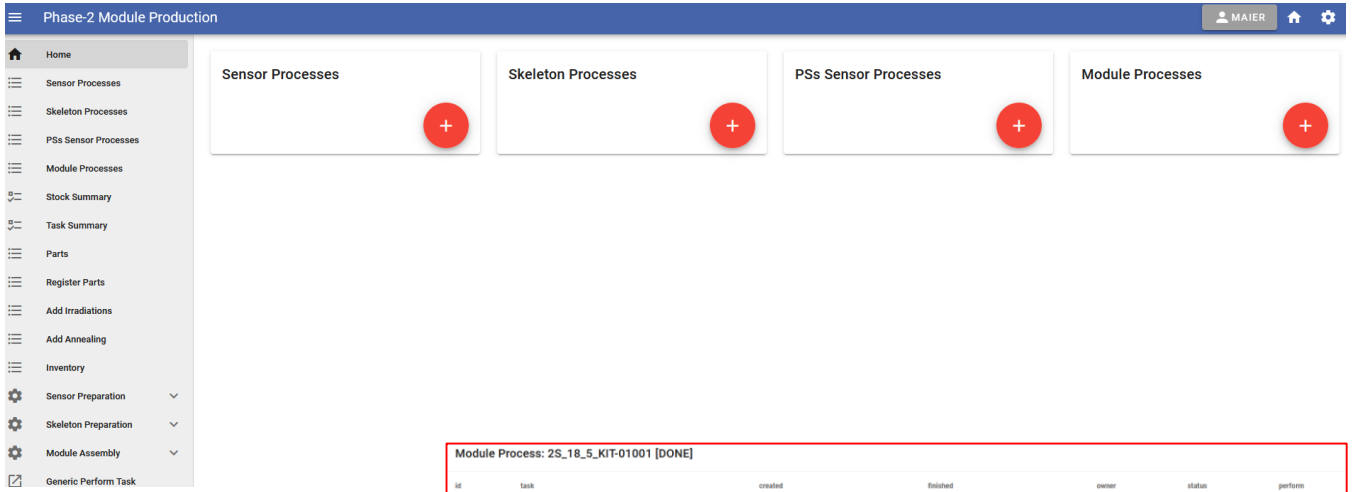

3. Tail bonding
11. Encap-sulation
2. Kapton gluing
4. Tail encapsulation
5. HV/IV Test
6. Bare module
9. Wire-bonding
13. Storage
Bonding Area
Glue Preparation & Dispensing Gantry
Rolling Table
Polymide/ HV Tail gluing and tail encapsulation
HV/IV Test
Hybrid Assembly
Bare Module Assembly
Module Test & Optical Inspection
DB Terminal
Metrology
7. Metrology
ESD
8. Hybrid gluing
10. Module test
12. Module test
1. Glue polyimide HV isolation and attach HV tails on sensor backside
2. Wire-bond and encapsulate HV tails
3. Glue sensors on Al-CF brides
Check dicing precision (metrology)
Optical inspection
HV test backside isolation
Sensor I(V)
Module metrology
6. Encapsulate wire-bonds
5. Place ~4000 wire-bonds
4. Glue readout and service hybrids on bare module
Module test
Module test
Optical inspection
(HV/LV test)

ETP Database Front-end

- Each assembly step is tracked via an web-accessible front-end
  - Assembly
  - Measurements
  - Visual inspection
- Big Brother is watching you
  - Who, when, which tool (jig, station), which components,…



ETP Database Front-end



List of Module-Processes:

Part

Status

part	id	created	finished	status	open tasks
2S_18_5_KIT-01001	68	15.4.2024, 11:33:00	15.8.2024, 15:50:23	DONE	
2S_18_5_KIT-00105	65	9.8.2023, 09:38:13		NEW	glue skeleton,
2S_18_5_KIT-00104	64	8.8.2023, 08:12:30		NEW	undefined, undefined,
2S_18_6_KIT-00103	63	7.8.2023, 13:00:21		NEW	glue skeleton,
2S_18_5_KIT-00102	62	4.8.2023, 09:58:15		NEW	glue skeleton,
2S_18_5_KIT-00101	61	3.8.2023, 10:14:06		NEW	glue skeleton,
2S_18_5_KIT-00011	46	20.7.2023, 09:54:09	15.8.2024, 15:50:38	DONE	
2S_18_6_KIT-00010	45	18.7.2023, 14:11:09	15.8.2024, 15:51:15	DONE	
2S_40_6_KIT-00009	39	11.1.2023, 11:40:48	24.7.2023, 14:36:35	DONE	
2S_18_6_KIT-00008	36	8.7.2022, 16:44:50	24.7.2023, 14:31:22	DONE	

Rows per page: 10 1-10 of 19

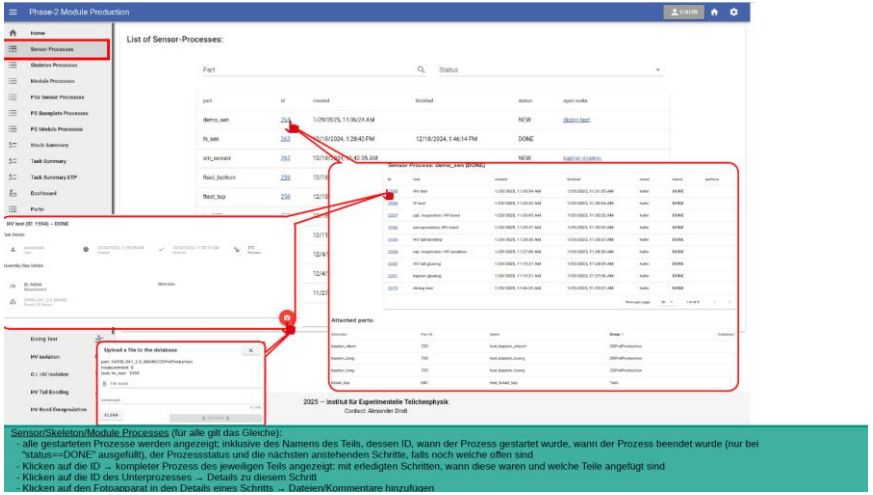
Module Process: 2S_18_5_KIT-01001 [DONE]

id	task	created	finished	owner	status	perform
985	burnin	18.4.2024, 09:44:11	15.8.2024, 15:50:23	maier	DONE	
984	module test: encapsulation	18.4.2024, 09:44:04	18.4.2024, 09:44:11	maier	DONE	
983	opt. inspection: encapsulation	18.4.2024, 09:43:57	18.4.2024, 09:44:04	maier	DONE	
981		18.4.2024, 09:43:46	18.4.2024, 09:43:49	maier	DONE	
980		18.4.2024, 09:43:46	18.4.2024, 09:43:52	maier	DONE	
979		18.4.2024, 09:43:46	18.4.2024, 09:43:54	maier	DONE	
978		18.4.2024, 09:43:46	18.4.2024, 09:43:57	maier	DONE	
976	module test: wire bonding	18.4.2024, 09:43:38	18.4.2024, 09:43:46	maier	DONE	
975		18.4.2024, 09:43:32	18.4.2024, 09:43:38	maier	DONE	
973		18.4.2024, 09:43:11	18.4.2024, 09:43:16	maier	DONE	
972		18.4.2024, 09:42:58	18.4.2024, 09:43:10	maier	DONE	
971		18.4.2024, 09:42:58	18.4.2024, 09:43:32	maier	DONE	
969		18.4.2024, 09:42:51	18.4.2024, 09:42:58	maier	DONE	
968	opt. inspection: hybrid glueing	18.4.2024, 09:42:47	18.4.2024, 09:42:51	maier	DONE	
959	glue skeleton	15.4.2024, 13:32:47	18.4.2024, 09:42:47	maier	DONE	

Front-end How To Made by Lorena

Name	Änderungsdatum	Typ	Größe
Documentation_en	05.02.2025 09:52	OpenDocument-P...	10.178 KB
Documentation_en	05.02.2025 09:52	Adobe Acrobat-D...	6.550 KB
Dokumentation_de	05.02.2025 09:52	OpenDocument-P...	10.162 KB
Dokumentation_de	05.02.2025 09:52	Adobe Acrobat-D...	6.561 KB

- Stored in the CernBox folder
- Homework 2: Read it



Upcoming Exercise

- We do have parts for 15 complete modules
- This time, also exercise parallel assembly of multiple modules / day
- Wire-bond pull test should be done on all modules

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		Sum
Prepare sensors	4	4	4	4	4	2	2	2	2	2								30
Kaptonized sensors available			4	6	8	10	12	12	12	12	10	8						
Build bare module(s)			1	1	1	1	1	1	1	2	2	4						
Modules finished							1	1	1	1	1	1	1	2	2	4		15

- Assembly of multiple modules / day only at the end of the exercise leaving some margin as pipeline runs dry towards the end (no part injection anymore)
- Afterwards: Review and improve (April)
- New parts should be there in April / May, but who knows…

Assembly Team – Status

- Stefan
- Kai
- Waldemar
- Tobias
- Andreas
- Bernd
- Hans Jürgen
- Alexander
- Niyathi

- Thomas
- Lea — Busy writing
- Bogdan — Busy writing

- Lorena
- Leander
- Aurora — Contract starts in march?

2025_10	03.03.2025 Monday		04.03.2025 Tuesday		05.03.2025 Wednesday		06.03.2025 Thursday		07.03.2025 Friday	
	Task	Person	Task	Person	Task	Person	Task	Person	Task	Person
8:00 - 9:00			VI Kapton Gluing	Kai	VI Kapton Gluing	Kai	VI Kapton Gluing	Waldemar	VI Kapton Gluing	Waldemar
			VI Kapton Gluing	Waldemar	VI Kapton Gluing	Waldemar	VI Bare Modules	Kai	VI Bare Modules	Kai
			VI Kapton Gluing	Tobias	VI Kapton Gluing	Tobias	VI Bare Modules	Tobias	VI Bare Modules	Stefan
			VI Kapton Gluing	Andreas	VI Kapton Gluing	Andreas	VI Bare Modules	Andreas	VI Bare Modules	Andreas
					Dicing test	Lorena	VI Bare Modules	Stefan	VI Hybrid Gluing	Tobias
9:00 - 10:00			WB tails	Kai	WB tails	Waldemar	WB tails	Waldemar	WB tails	Waldemar
			WB tails	Waldemar	WB tails	Bernd	WB tails	Bernd	WB tails	Bernd
			WB tails	Tobias	WB tails	Hans Jürgen	WB tails	Hans Jürgen	Encapsulate tails	Kai
			WB tails	Andreas	Encapsulate tails	Kai	Encapsulate tails	Kai	Encapsulate tails	Andreas
			WB tails	Bernd	Encapsulate tails	Tobias	Encapsulate tails	Tobias	Metrology	Stefan
			WB tails	Hans Jürgen	Encapsulate tails	Andreas	Encapsulate tails	Andreas		
10:00 - 11:00			Encapsulate tails	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai
			Encapsulate tails	Waldemar	Kapton gluing	Waldemar	Kapton gluing	Waldemar	WB modules	Hans Jürgen
			Encapsulate tails	Tobias	Kapton gluing	Tobias	Metrology	Tobias	WB modules	Waldemar
			Encapsulate tails	Andreas	Kapton gluing	Andreas	Metrology	Stefan	WB modules	Bernd
					Dicing test	Lorena	Metrology	Andreas	WB modules	Andreas
									WB modules	Tobias
11:00 - 12:00			VI Hybrids	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai
			VI Hybrids	Waldemar	Kapton gluing	Waldemar	Kapton gluing	Waldemar	WB modules	Hans Jürgen
			VI Hybrids	Tobias	Kapton gluing	Tobias	Kapton gluing	Tobias	WB modules	Waldemar
			VI Hybrids	Andreas	VI Bridges	Andreas	Kapton gluing	Andreas	WB modules	Bernd
					VI Bridges	Lorena			WB modules	Andreas
									WB modules	Tobias
13:00 - 14:00	Kapton gluing	Kai	Kapton gluing	Kai	HV/IV test	Lea	HV/IV test	Niyathi	HV/IV test	Niyathi
	Kapton gluing	Waldemar	Kapton gluing	Waldemar	HV/IV test	Niyathi	HV/IV test	Lea	HV/IV test	Alexander
	Kapton gluing	Tobias	Kapton gluing	Tobias	HV/IV test	Alexander	HV/IV test	~~Alexander~~	Bare modules assembly	Kai
	Kapton gluing	Andreas	Kapton gluing	Andreas	HV/IV test	Tobias	Bare modules assembly	Kai	Bare modules assembly	Andreas
					HV/IV test	Andreas	Bare modules assembly	Andreas		
					VI Bridges	Lorena	Bare modules assembly	Tobias		
14:00 - 15:00	Kapton gluing	Kai	Kapton gluing	Kai	HV/IV test	Lea	HV/IV test	Niyathi	HV/IV test	Niyathi
	Kapton gluing	Waldemar	Kapton gluing	Waldemar	HV/IV test	Niyathi	HV/IV test	Lea	HV/IV test	Alexander
	Kapton gluing	Tobias	Kapton gluing	Tobias	HV/IV test	Alexander	HV/IV test	~~Alexander~~	Bare modules assembly	Kai
	Kapton gluing	Andreas	Kapton gluing	Andreas	HV/IV test	Tobias	Bare modules assembly	Kai	Test modules before encaps.	Stefan
					HV/IV test	Andreas	Bare modules assembly	Andreas	Test modules before encaps.	Andreas
					VI Bridges	Lorena	Bare modules assembly	Tobias	Test modules before encaps.	Tobias
15:00 - 16:00	Kapton gluing	Kai	VI Hybrids	Kai	Bare modules assembly	Kai	Hybrid gluing	Kai	Hybrid gluing	Kai
	Kapton gluing	Waldemar	VI Hybrids	Waldemar	Bare modules assembly	Waldemar	Hybrid gluing	Waldemar	Encapsulate modules	Waldemar
	Kapton gluing	Tobias	VI Hybrids	Tobias	Bare modules assembly	Tobias	Hybrid gluing	Tobias	Encapsulate modules	Tobias
	Kapton gluing	Andreas	VI Hybrids	Andreas	Bare modules assembly	Andreas	Hybrid gluing	Andreas	Encapsulate modules	Andreas
					VI Bridges	Lorena				
16:00 - 17:00	VI Hybrids	Kai	Assembly and test skeletons	Stefan	Bare modules assembly	Kai	Hybrid gluing	Kai	Hybrid gluing	Kai
	VI Hybrids	Waldemar	Assembly and test skeletons	Kai	Bare modules assembly	Waldemar	Hybrid gluing	Waldemar	Encapsulate modules	Waldemar
	VI Hybrids	Tobias	Assembly and test skeletons	Waldemar	Bare modules assembly	Tobias	Hybrid gluing	Tobias	Encapsulate modules	Tobias
	VI Hybrids	Andreas	Assembly and test skeletons	Tobias	Bare modules assembly	Andreas	Hybrid gluing	Andreas	Encapsulate modules	Andreas
	Assembly and test skeletons	Stefan	Assembly and test skeletons	Andreas	VI Bridges	Lorena				
	Assembly and test skeletons	Leander	Assembly and test skeletons	Leander						

Typ	5CP 18	6CP 18	6CP 40	5CP 18	6CP 18	6CP 40	5CP 18	6CP 18	6CP 40	5CP 18	6CP 18	6CP 40	5CP 18	6CP 18	6CP 40
Kapton	0	4	0	0	4	0	0	4	0	0	4	0	0	4	0
Bare Module	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0

VTRX Length	12 cm	30 cm	12 cm	30 cm	12 cm	30 cm	12 cm	30 cm	12 cm	30 cm
Skeletons	2	0	2	0	0	0	0	0	0	0
Hybrid	2	0	13	0	0	0	0	0	0	0

Kommentar										
	9:00 Kick-off Meeting									

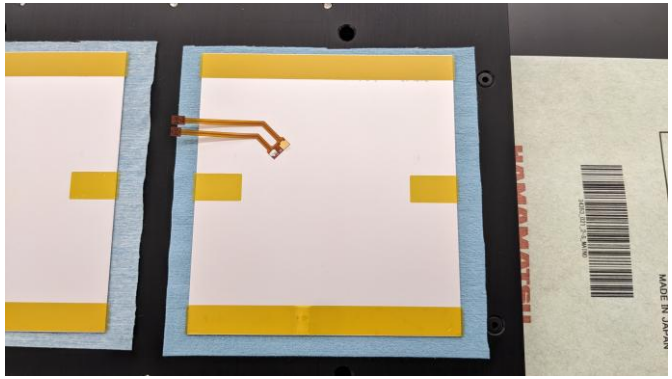
2025_11	10.03.2025 Monday		11.03.2025 Tuesday		12.03.2025 Wednesday		13.03.2025 Thursday		14.03.2025 Friday	
	Task	Person	Task	Person	Task	Person	Task	Person	Task	Person
8:00 - 9:00	VI Kapton Gluing	Waldemar	VI Kapton Gluing	Waldemar	VI Kapton Gluing	Waldemar	VI Kapton Gluing	Waldemar	VI Kapton Gluing	Waldemar
	VI Bare Modules	Kai	VI Bare Modules	Kai	VI Bare Modules	Kai	VI Bare Modules	Kai	VI Bare Modules	Kai
					VI Hybrid Gluing	Tobias				
	VI Hybrid Gluing	Tobias	VI Hybrid Gluing	Tobias	VI Hybrid Gluing	Andreas	VI Hybrid Gluing	Tobias	VI Hybrid Gluing	Tobias
	VI Hybrid Gluing	Andreas	VI Hybrid Gluing	Andreas	VI Bridges	Lorena	VI Hybrid Gluing	Andreas	VI Hybrid Gluing	Andreas
9:00 - 10:00	WB tails	Waldemar	WB tails	Waldemar	WB tails	Waldemar	WB tails	Waldemar	WB tails	Waldemar
	WB tails	Bernd	WB tails	Bernd	WB tails	Bernd	WB tails	Bernd	WB tails	Bernd
	Encapsulate tails	Kai	Encapsulate tails	Kai	Encapsulate tails	Kai	Encapsulate tails	Kai	Encapsulate tails	Kai
	Encapsulate tails	Andreas	Encapsulate tails	Andreas	Encapsulate tails	Andreas	Encapsulate tails	Andreas	Metrology	Andreas
	Metrology	Stefan	Metrology	Stefan	Metrology	Stefan	Metrology	Stefan		
					VI Bridges	Lorena				
10:00 - 11:00	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai
	WB modules	Hans Jürgen	WB modules	Hans Jürgen	WB modules	Hans Jürgen	WB modules	Hans Jürgen	WB modules	Hans Jürgen
	WB modules	Waldemar	WB modules	Waldemar	WB modules	Waldemar	WB modules	Waldemar	WB modules	Waldemar
	WB modules	Bernd	WB modules	Bernd	WB modules	Bernd	WB modules	Bernd	WB modules	Bernd
	WB modules	Andreas	WB modules	Andreas	WB modules	Andreas	WB modules	Andreas	WB modules	Andreas
					VI Bridges	Lorena				
11:00 - 12:00	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai	Kapton gluing	Kai
	WB modules	Waldemar	WB modules	Waldemar	WB modules	Waldemar	WB modules	Waldemar	WB modules	Waldemar
	WB modules	Bernd	WB modules	Bernd	WB modules	Bernd	WB modules	Bernd	WB modules	Bernd
	WB modules	Andreas	WB modules	Andreas	WB modules	Andreas	WB modules	Andreas	WB modules	Andreas
	HV/IV test	Alexander	HV/IV test	Stefan	HV/IV test	Alexander	HV/IV test	Niyathi	HV/IV test	Stefan
					VI Bridges	Lorena	HV/IV test	Alexander		
13:00 - 14:00	HV/IV test	Alexander	HV/IV test	Stefan	HV/IV test	Alexander	HV/IV test	Niyathi	HV/IV test	Stefan
							HV/IV test	Alexander		
	Bare modules assembly	Kai	Bare modules assembly	Kai	Bare modules assembly	Kai	Bare modules assembly	Kai	Bare modules assembly	Kai
	Bare modules assembly	Andreas	Bare modules assembly	Andreas	Bare modules assembly	Andreas	Bare modules assembly	Andreas	Bare modules assembly	Andreas
	Test modules before encaps.	Stefan								
	Test modules before encaps.	Leander								
14:00 - 15:00	Bare modules assembly	Kai	Bare modules assembly	Kai	Bare modules assembly	Kai	Bare modules assembly	Kai	Bare modules assembly	Kai
	Bare modules assembly	Andreas	Bare modules assembly	Andreas	Bare modules assembly	Andreas	Bare modules assembly	Andreas	Bare modules assembly	Andreas
	Assembly and test skeletons	Stefan	Test modules before encaps.	Stefan	Test modules before encaps.	Stefan	Test modules before encaps.	Stefan		Stefan
	Assembly and test skeletons	Leander	Test modules before encaps.	Leander	Test modules before encaps.	Leander	Test modules before encaps.	Leander		
15:00 - 16:00	Hybrid gluing	Kai	Hybrid gluing	Kai	Hybrid gluing	Kai	Hybrid gluing	Kai	Hybrid gluing	Kai
	Encapsulate modules	Waldemar	Encapsulate modules	Waldemar	Encapsulate modules	Waldemar	Encapsulate modules	Waldemar	Encapsulate modules	Waldemar
	Encapsulate modules	Tobias	Encapsulate modules	Tobias	Encapsulate modules	Tobias	Encapsulate modules	Tobias	Encapsulate modules	Tobias
	Encapsulate modules	Andreas	Encapsulate modules	Andreas	Encapsulate modules	Andreas	Encapsulate modules	Andreas	Encapsulate modules	Andreas
	Assembly and test skeletons	Stefan	Test modules after encaps.	Stefan	Test modules after encaps.	Stefan	Test modules after encaps.	Stefan	Test modules before encaps.	Stefan
	Assembly and test skeletons	Leander	Test modules after encaps.	Leander	Test modules after encaps.	Leander	Test modules after encaps.	Leander		
16:00 - 17:00	Hybrid gluing	Kai	Hybrid gluing	Kai	Hybrid gluing	Kai	Hybrid gluing	Kai	Hybrid gluing	Kai
	Encapsulate modules	Waldemar	Encapsulate modules	Waldemar	Encapsulate modules	Waldemar	Encapsulate modules	Waldemar	Encapsulate modules	Waldemar
	Encapsulate modules	Tobias	Encapsulate modules	Tobias	Encapsulate modules	Tobias	Encapsulate modules	Tobias	Encapsulate modules	Tobias
	Encapsulate modules	Andreas	Encapsulate modules	Andreas	Encapsulate modules	Andreas	Encapsulate modules	Andreas	Encapsulate modules	Andreas
	Assembly and test skeletons	Stefan	Test modules after encaps.	Stefan	Test modules after encaps.	Stefan	Test modules after encaps.	Stefan	Test modules after encaps.	Stefan
	Assembly and test skeletons	Leander	Test modules after encaps.	Leander	Test modules after encaps.	Leander	Test modules after encaps.	Leander		

Typ	5CP 18	6CP 18	6CP 40	5CP 18	6CP 18	6CP 40	5CP 18	6CP 18	6CP 40	5CP 18	6CP 18	6CP 40	5CP 18	6CP 18	6CP 40
Kapton	0	2	0	0	2	0	0	2	0	0	2	0	0	2	0
Bare Module	0	1	0	0	1	0	0	1	0	0	1	0	0	2	0

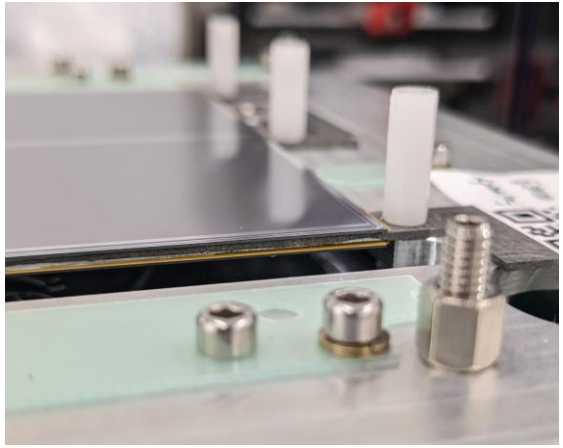
VTRX Length	12 cm	30 cm	12 cm	30 cm	12 cm	30 cm	12 cm	30 cm	12 cm	30 cm
Skeletons	11	0	0	0	0	0	0	0	0	0
Hybrid	0	0	0	0	0	0	0	0	0	0

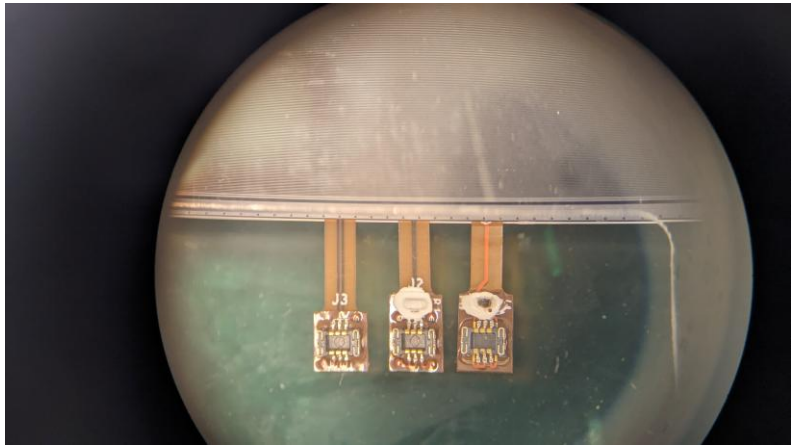
Kommentar	KSETA Plenary Workshop	KSETA Plenary Workshop | Besuch Dr. Koppenhöfer	KSETA Plenary Workshop		DPG Rehearsals

Mistakes happen!



- Don’t feel bad
- Important is that we learn from them and how to avoid them in future!
- Always report and document, this helps all other people avoiding them!





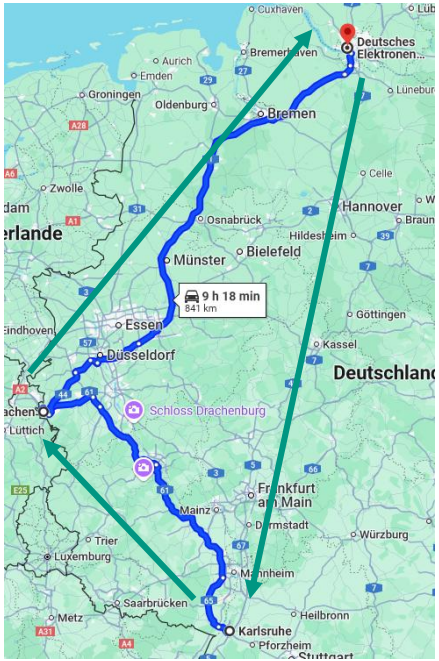
BACKUP

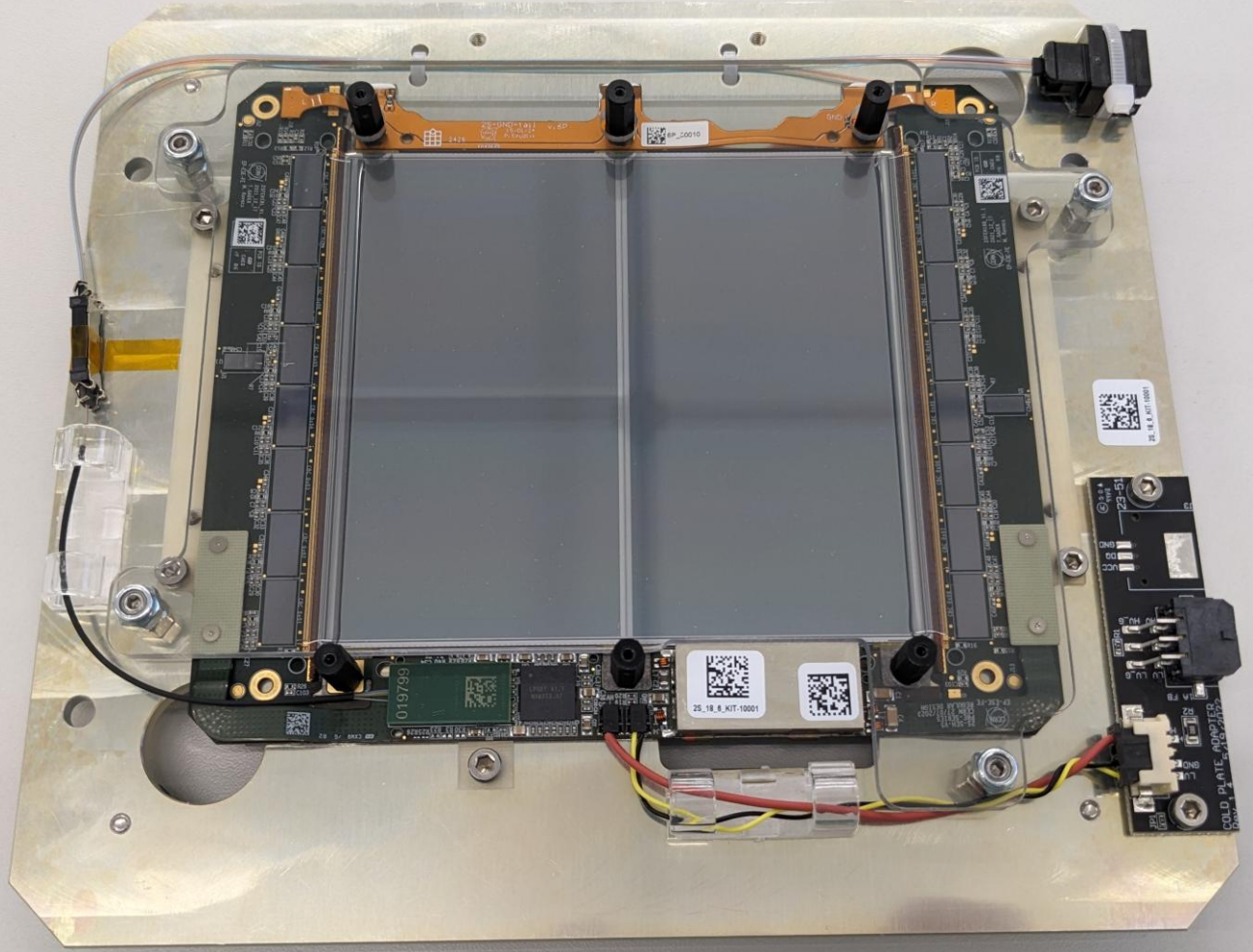
Logistics

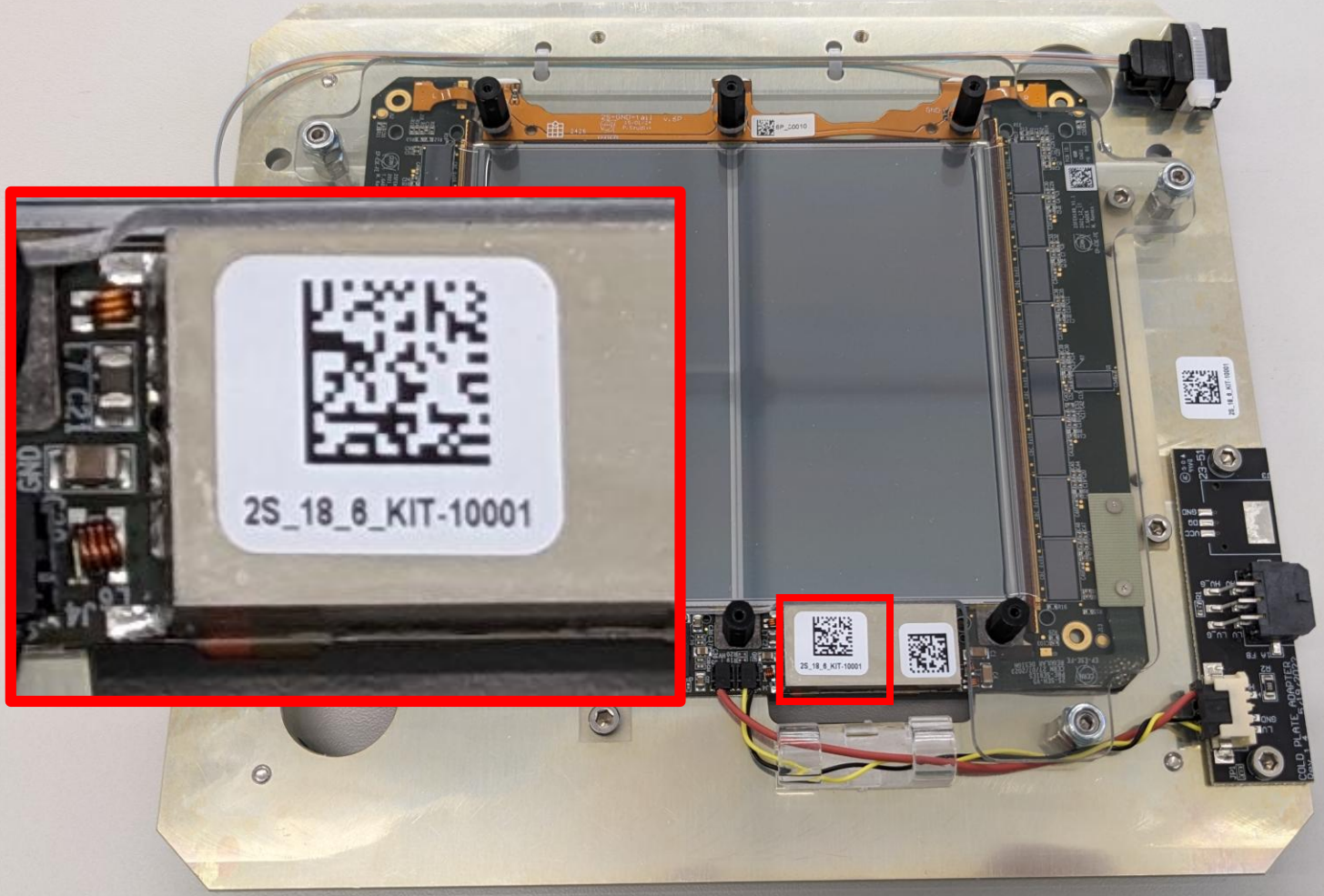
- According to the module flow a large fraction of our modules will go to DESY
  - Same for Aachen
- Idea: Book a courier which
  - Picks up full boxes at KIT
  - Picks up full boxes at Aachen
  - Delivery boxes to DESY, picks up empty boxes from previous delivery
  - Drives back, stores empty boxes in his storage unit (~2 weeks)
  - Picks up full boxes at KIT, brings back empty boxes from storage unit
  - Picks up full boxes at Aachen, brings back empty boxes from storage unit

Round robin

- First offer from a courier used in Phase 1: **1755€ per round**
- Alternative: DHL express mail (insured)




25_18_8_KIT-10001
COLD_PLATE_ADAPTER


2S_18_6_KIT-10001
GND
C21
2S_18_6_KIT-10001
COLD_PLATE_ADAPTER


Bonding Area
Glue Preparation &
Dispensing Gantry
Polymide/ HV Tail gluing
and tail encapsulation

FTE

- We put quite some effort defining on how much time is needed for which step
  - Scalable and granular down to minutes
- Out of experience **wire-bonding** and everything implying the usage of **glue** should by done by a technician
- Real numbers hard to estimate without having real parts in large quantities
- In the end the amount of work must fit in usual and realistic working hours

Parameter	Time [min]	
Modules per day	6	
Glue preparaton and cleanin	20	
SQC Fraction	0,05	
IT Measurements/ Module	0,5	
Documentation step	3	

Arbeitstage / Jahr	220
Krankheitstage / Jahr	15
Urlaub / Jahr	30
Skalierung	1,25714286

	Time			Distribution among				
Work	**Time [min]**	**h [dec]**	**Time[hh:mm:ss]**	**Administrative Staff**	**HiWi**	**Postdoc**	**PHD**	**Tec**
Unpacking	78,00	1,30		78	0	0	0	0
Reception tests	128,00	2,13		0	128	0	0	0
Sensor metrology	118,00	1,97		0	118	0	0	0
Sensor backside isolation	212,00	3,53		0	0	0	0	212
HV Tail wire-bonding	42,20	0,70		0	0	0	0	42,2
HV Tail encapsulation	50,00	0,83		0	0	0	0	50
HV IV Test	102,00	1,70		0	0	0	102	0
Bare module gluing	182,00	3,03		0	0	0	0	182
Metrology	84,00	1,40		0	0	0	84	0
Hybrid gluing	158,00	2,63		0	0	0	0	158
FEH wire-bonding	479,00	7,98		0	0	0	0	479
Module test	108,00	1,80		0	108	0	0	0
Encapsulation	152,00	2,53		0	0	0	0	152
Module test	108,00	1,80		0	108	0	0	0
Burn in	55,50	0,93		0	0	55,5	0	0
Packaging	59,00	0,98		59	0	0	0	0
Shipping	30,00	0,50		30	0	0	0	0
Total	2145,70	35,76		167	462	55,5	186	1275,2
				Administrative Staff	HiWi	Postdoc	PHD	Tec
FTE (8h/day)		4,47		0,35	0,96	0,12	0,39	2,66
FTE needed (corrected)		5,62		**0,44**	**1,21**	**0,15**	**0,49**	**3,34**
FTE available		5,3		**0,5**	**0,4**	**0,8**	**0,4**	**3,2**
Difference		-0,32		0,06	-0,81	0,65	-0,09	-0,14
New FTE		2		0	0,4	0,8	0	0,8
Difference with new people		1,68		0,06	-0,41	1,45	-0,09	0,66

- I put up a schedule describing the work that needs to be done **within the clean room** (no burn-in, packaging, shipping, organization etc…) estimating how many people we need **at minimum** and what constraints we have in the assembly flow

Schedule (≥4 modules / day)

Person / Time	FTE 1	FTE 2	FTE 3	FTE 4	FTE 5
8:00 – 9:00					
9:00 – 10:00					
10:00 – 11:00					
11:00 – 12:00					
13:00 – 14:00					
14:00 – 15:00					
15:00 – 16:00					
16:00 – 17:00					

Schedule (≥4 modules / day)

DAY 1

Person / Time	FTE 1	FTE 2	FTE 3	FTE 4	FTE 5
8:00 – 9:00	Dicing test	Optical inspection hybrids bridges			
9:00 – 10:00	Kapton gluing				
10:00 – 11:00	Kapton gluing				
11:00 – 12:00	Kapton gluing				
13:00 – 14:00					
14:00 – 15:00					
15:00 – 16:00					
16:00 – 17:00					

Schedule (≥4 modules / day)

DAY 1
DAY 2

Person / Time	FTE 1	FTE 2	FTE 3	FTE 4	FTE 5
8:00 – 9:00	Dicing test	Optical inspection hybrids bridges		WB tails	
9:00 – 10:00	Kapton gluing				
10:00 – 11:00	Kapton gluing				
11:00 – 12:00	Kapton gluing				
13:00 – 14:00	Encapsulate Tails				
14:00 – 15:00					
15:00 – 16:00					
16:00 – 17:00					

Schedule

DAY 1
DAY 2
DAY 3

Person / Time	FTE 1	FTE 2	FTE 3	FTE 4	FTE 5
8:00 – 9:00	Dicing test	Optical inspection hybrids bridges	Assemble and test skeletons	WB tails	
9:00 – 10:00	Kapton gluing	HV/IV Test	Assemble and test skeletons		
10:00 – 11:00	Kapton gluing	HV/IV Test			
11:00 – 12:00	Kapton gluing	HV/IV Test			
13:00 – 14:00	Encapsulate Tails	Bare modules assembly			
14:00 – 15:00		Bare module assembly			
15:00 – 16:00		Bare module assembly			
16:00 – 17:00					

Constraint 1: Free Kapton gluing jigs after tail bonding
Constraint 2: Metrology machine used for dicing test and bare module metrology

Schedule

DAY 1
DAY 2
DAY 3
DAY 4

Person / Time	FTE 1	FTE 2	FTE 3	FTE 4	FTE 5
8:00 – 9:00	Dicing test	Optical inspection hybrids bridges	Assemble and test skeletons	WB tails	
9:00 – 10:00	Kapton gluing	HV/IV Test	Assemble and test skeletons		
10:00 – 11:00	Kapton gluing	HV/IV Test	Metrology		
11:00 – 12:00	Kapton gluing	HV/IV Test	Metrology		
13:00 – 14:00	Encapsulate Tails	Bare modules assembly	Hybrid gluing		
14:00 – 15:00		Bare module assembly	Hybrid gluing		
15:00 – 16:00		Bare module assembly	Hybrid gluing		
16:00 – 17:00					

Schedule

Constraint 1: Free Kapton gluing jigs after tail bonding
Constraint 2: Metrology machine used for dicing test and bare module metrology
Constraint 3: One person cannot bond for 8 hours
Constraint 4: Bonder used for tail and readout bonds

DAY 1
DAY 2
DAY 3
DAY 4
DAY 5

Person / Time	FTE 1	FTE 2	FTE 3	FTE 4	FTE 5
8:00 – 9:00	Dicing test	Optical inspection hybrids bridges	Assemble and test skeletons	WB tails	
9:00 – 10:00	Kapton gluing	HV/IV Test	Assemble and test skeletons	WB modules	
10:00 – 11:00	Kapton gluing	HV/IV Test	Metrology	WB modules	
11:00 – 12:00	Kapton gluing	HV/IV Test	Metrology	WB modules	
13:00 – 14:00	Encapsulate Tails	Bare modules assembly	Hybrid gluing		WB modules
14:00 – 15:00		Bare module assembly	Hybrid gluing		WB modules
15:00 – 16:00		Bare module assembly	Hybrid gluing		WB modules
16:00 – 17:00					WB modules

Schedule

Constraint 1: Free Kapton gluing jigs after tail bonding
Constraint 2: Metrology machine used for dicing test and bare module metrology
Constraint 3: One person cannot bond for 8 hours
Constraint 4: Bonder used for tail and readout bonds
Constraint 5: Dispensing gantry used for Kapton gluing and encapsulation

DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
DAY 6/7

Person / Time	FTE 1	FTE 2	FTE 3	FTE 4	FTE 5
8:00 – 9:00	Dicing test	Optical inspection hybrids bridges	Assemble and test skeletons	WB tails	Test modules before encaps.
9:00 – 10:00	Kapton gluing	HV/IV Test	Assemble and test skeletons	WB modules	Test modules before encaps.
10:00 – 11:00	Kapton gluing	HV/IV Test	Metrology	WB modules	
11:00 – 12:00	Kapton gluing	HV/IV Test	Metrology	WB modules	
13:00 – 14:00	Encapsulate Tails	Bare modules assembly	Hybrid gluing		WB modules
14:00 – 15:00	Encapsulate modules	Bare module assembly	Hybrid gluing		WB modules
15:00 – 16:00	Encapsulate modules	Bare module assembly	Hybrid gluing		WB modules
16:00 – 17:00	Encapsulate modules				WB modules

Schedule

Constraint 1: Free Kapton gluing jigs after tail bonding
Constraint 2: Metrology machine used for dicing test and bare module metrology
Constraint 3: One person cannot bond for 8 hours
Constraint 4: Bonder used for tail and readout bonds
Constraint 5: Dispensing gantry used for Kapton gluing and encapsulation

DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
DAY 6/7
DAY 8

Person / Time	FTE 1	FTE 2	FTE 3	FTE 4	FTE 5
8:00 – 9:00	Dicing test	Optical inspection hybrids bridges	Assemble and test skeletons	WB tails	Test modules before encaps.
9:00 – 10:00	Kapton gluing	HV/IV Test	Assemble and test skeletons	WB modules	Test modules before encaps.
10:00 – 11:00	Kapton gluing	HV/IV Test	Metrology	WB modules	Test modules after encaps.
11:00 – 12:00	Kapton gluing	HV/IV Test	Metrology	WB modules	Test modules after encaps.
13:00 – 14:00	Encapsulate Tails	Bare modules assembly	Hybrid gluing		WB modules
14:00 – 15:00	Encapsulate modules	Bare module assembly	Hybrid gluing		WB modules
15:00 – 16:00	Encapsulate modules	Bare module assembly	Hybrid gluing		WB modules
16:00 – 17:00	Encapsulate modules				WB modules